TABLE OF CONTENTS

SECTION 003132 - GEOTECHNICAL DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes description of geotechnical engineering investigation report (soils report) at the Site, and use of data resulting from that investigation.

1.3 RECORDS OF INVESTIGATIONS

A. The records of soil and subsurface investigations are available as a reference to the Contractor.

1.4 GEOTECHNICAL ENGINERING INVESTIGATION REPORT

A. A geotechnical engineering investigation report has been prepared for this Project by Construction Testing & Engineering, Inc. dated December 8, 2016 and supplemental letter (addendum) dated May 1, 2017.

B. The report shall be used by the Contractor as a guide for all earthwork, trenching, installation of foundations, and all other below-grade work. The Contractor is cautioned that while the report (investigation) may be used for assistance, all responsibility for subsurface conditions and execution of the documents based on recommendations in the report shall remain with the Contractor. When conditions revealed by the Contractor's excavation are at variance with the geotechnical report, the changed conditions must be evaluated by the Owner's geotechnical engineer, with additional recommendations made if required. Applicable recommendations shall be followed, but specific requirements shown on the drawings and in each of the Division 2 through 33 Sections shall take precedence over the general recommendations in the report.

C. Use of Data.

1. The geotechnical report was obtained only for the Architect's and Engineer's use in design and is not a part of the Contract Documents.
2. The report is available for the Contractor's information, but is not a warranty of subsurface conditions.
3. Contractor shall visit the site and become familiar with existing conditions.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. The Contractor may take additional soil borings or make other explorations, without additional cost to the Owner, to make further determinations of site soil or subsurface conditions. Coordinate additional exploratory Work with Architect and Owner so as not to interfere with Owner's use of the site.

B. Upon completion of additional exploratory Work, backfill the test holes and pits using removed material. If removed material is not sufficient, provide additional compactable material of similar character to the native soil. Compact the backfill to same density as adjacent soil.

C. The Contractor shall be fully responsible for any deductions or conclusions made on the basis of any information or data collected from this additional exploratory Work.

3.2 GENERAL

A. A geotechnical engineer will be retained by the Owner to observe performance of Work in connection with all earthwork, excavating, trenching, filling, backfilling, and grading, and to perform compaction tests.

B. Re-adjust Work performed that does not meet technical or design requirements, but make no deviation from the Contract Documents without specific and written approval from the Architect.

C. In addition to complying with the requirements of the authorities having jurisdiction, comply with the recommendations of the geotechnical engineer at the jobsite during earthwork operations. Notify Architect and/or Engineer of any discrepancies between the Contract Documents and the actual site conditions.

END OF SECTION 003132

SECTION 012100 - ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements governing allowances.

B. Types of allowances include the following:

1. Lump-sum allowances.

C. Related Requirements:

1. Section 014000 "Quality Requirements" for procedures governing the use of allowances for testing and inspecting.

1.3 DEFINITIONS

A. Allowance is a quantity of work or dollar amount established in lieu of additional requirements, used to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.

1.4 SELECTION AND PURCHASE

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

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

C. Purchase products and systems selected by Architect from the designated supplier.

1.5 ACTION SUBMITTALS

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

1.6 INFORMATIONAL SUBMITTALS

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

B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.

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

1.7 COORDINATION

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

1.8 LUMP-SUM, UNIT-COST, AND QUANTITY ALLOWANCES

A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight, and delivery to Project site.

B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials under allowance shall be included as part of the Contract Sum and not part of the allowance.

C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.

1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.9 ADJUSTMENT OF ALLOWANCES

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

1. Include installation costs in purchase amount only where indicated as part of the allowance.
2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
3. Submit substantiation of a change in scope of work, if any, claimed in Change Orders related to unit-cost allowances.
4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.

B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.

1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of work has changed from what could have been foreseen from information in the Contract Documents.
2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

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

3.3 SCHEDULE OF ALLOWANCES

A. Allowance No. 1: Gypsum / Hydraulic Cement Underlayment Lump-Sum Allowance: Include in the sum an allowance for floating floor substrates with gypsum cement underlayment (at wood floors) and hydraulic cement underlayment (at concrete floors) which are not in compliance with specified tolerances and finish flooring manufacturer's written limitations.

B. Allowance No. 2: Moisture Vapor Emission Control Lump-Sum Allowance: Include in the sum an allowance for application of moisture vapor emission control system that controls the moisture-vapor-emission rate of high-moisture interior concrete floor slabs which are not in compliance with finish flooring manufacturer's written limitations.

END OF SECTION 012100

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

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

1. Substitutions for cause.
2. Substitutions for convenience.

a. Architect will consider substitution for convenience requests if written request and all of the supporting action submittals are received by the Architect within the time limitations established by the General Conditions for substitutions. If no time limit is established in the General Conditions for substitutions, Architect will consider substitution for convenience requests if received prior to bid due date. Requests received after that time may be considered or rejected at discretion of Architect.

3. Refer to Section 016000 “Product Requirements” (NOT this Section) for comparable products being submitted for consideration as one of the following:

a. “Or Equal.”
b. “Or Comparable Equal.”

B. Related Requirements:

1. Section 012100 "Allowances" for products selected under an allowance.
2. Section 016000 "Product Requirements" for requirements related to comparable products being submitted for consideration via "Or Equal" or via "Or Comparable Equal."

1.3 DEFINITIONS

A. Day: The term “day” as used in this Section shall mean calendar day, including weekends and legal holidays.

B. Business Day: The term “business day” shall mean working day, excluding weekends and legal holidays.

C. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product*, regulatory changes, or unavailability of required warranty terms.

* The Contractor's failure to obtain in a timely manner one of the specified products (e.g. a contractor-caused submittal delay, contractor did not take into consideration for long-lead time, etc.) is NOT considered a justifiable substitution request for cause.

2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 ACTION SUBMITTALS

A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use CSI Form 13.1A “Substitution Request for Cause” following this Section.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

a. Executive Summary: In addition to the requirements noted above and below, provide an executive summary, which compares the significant technical properties and characteristics between the original product specified and the proposed substitution. Such summary shall be limited to two pages, and shall be presented in a matrix or bullet format. Where visual or aesthetic criteria are a component of the comparison, provide samples of both the original product specified and the proposed substitution.
b. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
c. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
d. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
e. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
f. Samples, where applicable or requested.
g. Certificates and qualification data, where applicable or requested.
h. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
i. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
j. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
k. Sustainable design characteristics equal to or better than product(s) specified.
l. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
m. Cost information, including a proposal of change, if any, in the Contract Sum.
n. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
o. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within five (5) business days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 10 business days of receipt of request, or 5 business days of receipt of additional information or documentation, whichever is later.

a. Forms of Acceptance: Change Order.
b. Requests for substitution must be approved in writing by Owner, Architect, and as applicable Authorities Having Jurisdiction.
c. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.
d. Provide specified product(s) when request for substitution has been rejected.

1.5 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.7 SPECIAL WARRANTY

A. Special Contractor Warranty for Substitutions for Convenience: Contractor warrants that substituted material or system will perform same as original specified material or system would have performed. Should accepted substitution fail to perform as required, Contractor shall replace substituted material or system with that specified and bear costs incurred thereby.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests and action submittals for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
b. Requested substitution provides sustainable design characteristics that specified product provided.
c. Substitution request is fully documented and properly submitted.
d. Requested substitution will not adversely affect Contractor's construction schedule.
e. Requested substitution has received necessary approvals of authorities having jurisdiction.
f. Requested substitution is compatible with other portions of the Work.
g. Requested substitution has been coordinated with other portions of the Work.
h. Requested substitution provides specified warranty.
i. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
j. Requested substitution meets or exceeds the specified requirements and salient performance characteristics of the specified product or system.

B. Substitutions for Convenience: Architect will consider requests for substitution if written request and all of the supporting action submittal are received by the Architect within the time frame established by the General Conditions. If no time limit is established in the General Conditions for substitutions, Architect will consider substitution for convenience requests if received prior to bid due date. Requests received after that time may be considered or rejected at discretion of Architect.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
b. Requested substitution does not require extensive revisions to the Contract Documents.
c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
d. Requested substitution provides sustainable design characteristics that specified product provided.
e. Substitution request is fully documented and properly submitted.
f. Requested substitution will not adversely affect Contractor's construction schedule.
g. Requested substitution has received necessary approvals of authorities having jurisdiction.
h. Requested substitution is compatible with other portions of the Work.
i. Requested substitution has been coordinated with other portions of the Work.
j. Requested substitution provides specified warranty.
k. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
l. Requested substitution meets or exceeds the specified requirements and salient performance characteristics of the specified product or system. Include detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
m. Requested substitution will be executed by installer(s) that are certified by manufacturer of substituted product.
n. Samples of requested substitution are submitted, if requested.
o. The Owner shall be entitled to reimbursement from the Contractor for amounts paid to the Architect for reviewing the Contractor’s proposed substitutions for convenience and making agreed-upon changes in the Drawings and Specifications resulting from such substitutions.

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

CSI Form 13.1A

SUBSTITUTION REQUEST FOR CAUSE

Project: _____ Substitution Request Number: _____

_____ From: _____

To: _____ Date: _____

_____ A/E Project Number: _____

Re: _____ Contract For: _____

Specification Title: _____ Description: _____

Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____

Manufacturer: _____ Address: _____ Phone: _____

Trade Name: _____ Model No.: _____

Installer: _____ Address: _____ Phone: _____

History: ☐ New product ☐ 1-4 years old ☐ 5-10 years old ☐ More than 10 years old

Differences between proposed substitution and specified product: _____

_____

_____

☐ Point-by-point comparative data attached — REQUIRED BY A/E

Reason for not providing specified item: _____

_____

Similar Installation:

Project: _____ Architect: _____

Address: _____ Owner: _____

_____ Date Installed: _____

Proposed substitution affects other parts of Work: ☐ No ☐ Yes; explain _____

_____

Savings to Owner for accepting substitution: _____ ($ _____).

Proposed substitution changes Contract Time: ☐ No ☐ Yes [Add] [Deduct] _____ days.

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ _____

SUBSTITUTION
REQUEST FOR CAUSE
(Continued)

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted by: _____

Signed by: _____

Firm: _____

Address: _____

_____

Telephone: _____

Attachments: ☐

A/E's REVIEW AND ACTION

☐ Substitution approved - Make submittals in accordance with Specification Section 01 25 00 Substitution Procedures.
☐ Substitution approved as noted - Make submittals in accordance with Specification Section 01 25 00 Substitution Procedures.
☐ Substitution rejected - Use specified materials.
☐ Substitution Request received too late - Use specified materials.

Signed by: _____ Date: _____

Additional Comments: ☐ Contractor ☐ Subcontractor ☐ Supplier ☐ Manufacturer ☐ A/E ☐ Other:

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

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

B. Related Requirements:

1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

1.3 DEFINITIONS

A. Day: The term "day" as used in this Section shall mean calendar day, including weekends and legal holidays.

B. Business Day: The term “business day” shall mean working day, excluding weekends and legal holidays.

1.4 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."

1.5 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
2. Within 15 business days after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
c. Include costs of labor and supervision directly attributable to the change.
d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use form mutually acceptable to Owner, Architect, and Contractor.

1.6 ADMINISTRATIVE CHANGE ORDERS

A. Allowance Adjustment: See Section 012100 "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.

1.7 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Work Changes Proposal Request, Contractor will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. Related Requirements:

1. Section 012100 "Allowances" for procedural requirements governing the handling and processing of allowances.
2. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
3. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.3 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.

1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
3. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values coordinated with each phase of payment.
4. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values coordinated with each element.

B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the schedule of values:

a. Project name and location.
b. Name of Architect.
c. Architect's project number.
d. Contractor's name and address.
e. Date of submittal.

2. Arrange schedule of values consistent with format of AIA Document G703.
3. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:

    a. Related Specification Section or Division.
    b. Description of the Work.
    c. Name of subcontractor.
    d. Name of manufacturer or fabricator.
    e. Name of supplier.
    f. Change Orders (numbers) that affect value.
    g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.

        1) Labor.
        2) Materials.
        3) Equipment.

4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
6. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.

    a. Differentiate between items stored on-site and items stored off-site.

7. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
8. Overhead Costs: Include total cost and proportionate share of general overhead and profit for each line item.
9. Overhead Costs: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
10. Schedule of Values Revisions: Revise the schedule of values when Change Orders result in a change in the Contract Sum. Include at least one separate line item for each Change Order.

1.5 APPLICATIONS FOR PAYMENT

A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.

B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.

C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.

1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
3. Include amounts of Change Orders issued before last day of construction period covered by application.

E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.

1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
3. Provide summary documentation for stored materials indicating the following:

    a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
    b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
    c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

F. Transmittal: Submit minimum three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.

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

G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.

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

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

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

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

1. List of subcontractors.
2. Schedule of values.
3. Contractor's construction schedule (preliminary if not final).
4. Products list (preliminary if not final).
5. Sustainable design action plans, including preliminary project materials cost data.
6. Schedule of unit prices.
7. Submittal schedule (preliminary if not final).
8. List of Contractor's staff assignments.
9. List of Contractor's principal consultants.
10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
11. Initial progress report.
12. Report of preconstruction conference.
13. Certificates of insurance and insurance policies.
14. Performance and payment bonds.
15. Data needed to acquire Owner's insurance.

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

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

K. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements.
2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
3. Updated final statement, accounting for final changes to the Contract Sum.
4. AIA Document G706.
5. AIA Document G706.
6. AIA Document G707.
7. Evidence that claims have been settled.
8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

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

1. General coordination procedures.
2. Coordination drawings.
3. Requests for Information (RFIs).
4. Digital project management procedures.
5. Project meetings.

B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.

C. Related Requirements:

1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
3. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.
4. Section 019113 "General Commissioning Requirements" for coordinating the Work with Owner's Commissioning Authority.

1.3 DEFINITIONS

A. Day: The term "day" as used in this Section shall mean calendar day, including weekends and legal holidays.

B. BIM: Building Information Modeling.

C. Business Day: The term "business day" as used in this Section shall mean working day, excluding weekends and legal holidays.

D. RFI: Request for information from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, and telephone number of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

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

1.5 GENERAL COORDINATION PROCEDURES

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

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its operations with operations, included in different Sections, that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components with other contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

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

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

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

1. Preparation of Contractor's construction schedule.
2. Preparation of the schedule of values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

1.6 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:

a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
f. Indicate required installation sequences.
g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
6. Mechanical and Plumbing Work: Show the following:

a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
c. Fire-rated enclosures around ductwork.

7. Electrical Work: Show the following:

a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
d. Location of pull boxes and junction boxes, dimensioned from column center lines.

8. Fire-Protection System: Show the following:

a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.

9. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.
10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 013300 "Submittal Procedures."

C. Mechanical, Electrical, Plumbing, Fire Protection Coordination Digital Data Files: In additional to coordination drawing requirements above, prepare coordination digital data files according to the following requirements:

1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.

    a. Subcontractors shall be responsible for converting the digital data files received from design team into the format required for the overall subcontractor coordinated building information model.

2. BIM File Incorporation: Develop and incorporate coordination drawing files into Building Information Model established for Project.

    a. Perform three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Architect.

1.7 REQUESTS FOR INFORMATION (RFIs)

A. General Contractor and Trade Contractors providing preconstruction services shall not submit RFI's to Architect during the preconstruction phases of the Work. RFI's received by the Architect prior to obtaining formal approval(s) by authorities having jurisdiction will be returned without action.

B. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
3. Prior to submission of the RFI to the Architect, the General Contractor and Trade Contractor(s) shall evaluate and validate that the request seeking information or clarification is not available after a reasonable and appropriate review of the Contract Documents, filed conditions, other Owner-provided information, Contractor-prepared coordination drawings, or prior Project correspondence or documentation.

    a. The Owner is entitled to reimbursement from the Contractor for amounts paid to the Architect for evaluating and responding to the Contractor's requests for information that are not prepared in accordance with the Contract Documents or where the requested information is available to the Contractor from a careful study and comparison of the Contract Documents, field conditions, other Owner-provided information, Contractor-prepared coordination drawings, or prior Project correspondence or documentation.

4. When submitting ten or more concurrent RFI's related to a specific portion of the Work, regardless of whether the RFI's are submitted individually or combined, the General Contractor and Trade Contractor submitting the RFI's shall conduct a special coordination meeting.

    a. Include the following attendees: Entity originating the RFI's, Trade Contractor(s), General Contractor, Architect, Architect's Consultant (as required), Owner (as required), and other subcontractors, suppliers, etc. as required for coordination.

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

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

    a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

D. RFI Forms: AIA Document G716 or form mutually acceptable to Owner, Architect, and Contractor.

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

E. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow 5 business days for Architect's response for each RFI. RFIs received by Architect after 1:00 P.M. will be considered as received the following working day.

1. The following Contractor-generated RFIs will be returned without action:

    a. Requests for approval of submittals.
    b. Requests for approval of substitutions.
    c. Requests for approval of Contractor's means and methods.
    d. Requests for coordination information already indicated in the Contract Documents.
    e. Requests for adjustments in the Contract Time or the Contract Sum.
    f. Requests for interpretation of Architect's actions on submittals.
    g. Incomplete RFIs or inaccurately prepared RFIs.
    h. Requests during the preconstruction phases of Work.

2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."

    a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 business days of receipt of the RFI response.

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

1. Project name.
2. Name and address of Contractor.
3. Name and address of Architect.
4. RFI number including RFIs that were returned without action or withdrawn.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect's response was received.
8. Identification of related Architect’s Supplemental Information, Proposal Request, or Change Order.

G. On receipt of Architect’s action, Contractor shall update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within five business days if Contractor disagrees with response.

1.8 DIGITAL PROJECT MANAGEMENT PROCEDURES

A. Architect's Digital Data Files: At Contractor's written request and unless the provisions of the Owner/Architect Agreement provide otherwise, an electronic copy of Architect's Instruments of Services may be provided for appropriate Project purposes upon the execution by Owner and Contractor of Architect's "Electronic Document Release" form (a copy of which may be obtained from Architect).

1. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
2. Digital Data Software Program: Drawings are available in Revit format.
3. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Architect.

B. Web-Based Project Software: Provide, administer, and use web-based Project software for purposes of hosting and managing Project communication and documentation until Final Completion.

1. Web-based Project software site includes, at a minimum, the following features:

a. Compilation of Project data, including Contractor, subcontractors, Architect, architect's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.
b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.
c. Document workflow planning, allowing customization of workflow between project entities.
d. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.
e. Track status of each Project communication in real time, and log time and date when responses are provided.
f. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
g. Processing and tracking of payment applications.
h. Processing and tracking of contract modifications.
i. Creating and distributing meeting minutes.
j. Document management for Drawings, Specifications, and coordination drawings, including revision control.
k. Management of construction progress photographs.
l. Mobile device compatibility, including smartphones and tablets.

2. Provide web-based Project software user licenses for use of Owner, Owner's Commissioning Authority , Construction Manager, Architect, and Architect's consultants. Provide software training at Architect's office for web-based Project software users.
3. At completion of Project, provide digital archive in format that is readable by common desktop software applications in format acceptable to Architect. Provide data in locked format to prevent further changes.

C. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.9 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Contractor will record significant discussions and agreements achieved and will author meeting minutes. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.

B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.

1. Conduct the conference to review responsibilities and personnel assignments.
2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

3. Agenda: Discuss items of significance that could affect progress, including the following:

a. Responsibilities and personnel assignments
b. Tentative construction schedule.
c. Phasing.
d. Critical work sequencing and long-lead items.
e. Designation of key personnel and their duties.
f. Lines of communications.
g. Use of web-based Project software.
h. Procedures for processing field decisions and Change Orders.
i. Procedures for RFIs.
j. Procedures for testing and inspecting.
k. Procedures for processing Applications for Payment.
l. Distribution of the Contract Documents.
m. Submittal procedures.
n. Sustainable design requirements.
o. Preparation of record documents.
p. Use of the premises and existing building.
q. Work restrictions.
r. Working hours.
s. Owner's occupancy requirements.
t. Responsibility for temporary facilities and controls.
u. Procedures for moisture and mold control.
v. Procedures for disruptions and shutdowns.
w. Construction waste management and recycling.
x. Parking availability.
y. Office, work, and storage areas.
z. Equipment deliveries and priorities.
aa. First aid.
bb. Security.
cc. Progress cleaning.

4. Minutes: Contractor will record and distribute meeting minutes.

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

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

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

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Contractor shall record and distribute minutes of the meeting to each party present and to other parties requiring information.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.

1. Conduct the conference to review requirements and responsibilities related to Project closeout.
2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:

    a. Preparation of Record Documents.
    b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
    c. Procedures for completing and archiving web-based Project software site data files.
    d. Submittal of written warranties.
    e. Requirements for completing sustainable design documentation.
    f. Requirements for preparing operations and maintenance data.

g. Requirements for delivery of material samples, attic stock, and spare parts.
h. Requirements for demonstration and training.
i. Preparation of Contractor's punch list.
j. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
k. Submittal procedures.
l. Coordination of separate contracts.
m. Owner's partial occupancy requirements.
n. Installation of Owner's furniture, fixtures, and equipment.
o. Responsibility for removing temporary facilities and controls.

4. Minutes: Contractor will record and distribute meeting minutes.

E. Progress Meetings: Conduct progress meetings at weekly intervals.

1. Coordinate dates of meetings with preparation of payment requests.
2. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

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

1) Review schedule for next period.

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

1) Interface requirements.
2) Sequence of operations.
3) Resolution of BIM component conflicts.
4) Status of submittals.
5) Status of sustainable design documentation.
6) Deliveries.
7) Off-site fabrication.
8) Access.
9) Site utilization.
10) Temporary facilities and controls.
11) Progress cleaning.
12) Quality and work standards.
13) Status of correction of deficient items.
14) Field observations.
15) Status of RFIs.
16) Status of proposal requests.
17) Pending changes.
18) Status of Change Orders.
19) Pending claims and disputes.
20) Documentation of information for payment requests.

4. Minutes: Contractor will record and distribute the meeting minutes to each party present and to parties requiring information.

a. Schedule Updating: Revise Contractor's construction schedule monthly where revisions to the schedule have been made or recognized.

F. Coordination Meetings: Conduct Project coordination meetings at intervals appropriate to the state of construciton. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.

1. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

    a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
    b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
    c. Review present and future needs of each contractor present, including the following:

        1) Interface requirements.
        2) Sequence of operations.
        3) Resolution of BIM component conflicts.
        4) Status of submittals.
        5) Deliveries.
        6) Off-site fabrication.
        7) Access.
        8) Site use.
        9) Temporary facilities and controls.
        10) Work hours.
        11) Hazards and risks.
        12) Progress cleaning.
        13) Quality and work standards.
        14) Status of RFIs.
        15) Proposal Requests.
        16) Change Orders.
        17) Pending changes.

3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

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

1. Contractor's construction schedule.

B. Related Requirements:

1. Section 013300 "Submittal Procedures" for submitting schedules and reports.
2. Section 014000 "Quality Requirements" for submitting a schedule of tests and inspections.

1.3 DEFINITIONS

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

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

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

C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

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

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

1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

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

1.4 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:

1. Electronic copy of schedule file, where indicated.
2. PDF electronic file.

B. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

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

1.5 QUALITY ASSURANCE

A. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's construction schedule, including, but not limited to, the following:

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

1.6 COORDINATION

A. Coordinate Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.

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

1.7 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Time Frame: Extend schedule from date established for commencement of the Work to date of Substantial Completion and final completion.

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

B. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:

1. Activity Duration: Define duration of discrete activities.
2. Procurement Activities: Include procurement process activities for the following long lead items and major items, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
3. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
4. Startup and Testing Time: Include no fewer than 15 business days for startup and testing.
5. Commissioning Time: Include no fewer than 15 business days for commissioning.
6. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
7. Punch List and Final Completion: Include not more than 60 days for completion of punch list items and final completion.

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

1. Phasing: Arrange list of activities on schedule by phase.
2. Work under More Than One Contract: Include a separate activity for each contract.
3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
4. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
5. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
6. Work Restrictions: Show the effect of the following items on the schedule:

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

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

    a. Subcontract awards.
    b. Submittals.
    c. Purchases.
    d. Mockups.
    e. Fabrication.
    f. Sample testing.
    g. Deliveries.
    h. Installation.
    i. Tests and inspections.
    j. Adjusting.
    k. Curing.
    l. Building flush-out.
    m. Startup and placement into final use and operation.
    n. Commissioning.

8. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:

    a. Structural completion.
    b. Temporary enclosure and space conditioning.
    c. Permanent space enclosure.
    d. Completion of mechanical installation.
    e. Completion of electrical installation.
    f. Substantial Completeion.

D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.

E. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:

1. Unresolved issues.
2. Unanswered Requests for Information.
3. Rejected or unreturned submittals.
4. Notations on returned submittals.
5. Pending modifications affecting the Work and Contract Time

F. Contractor's Construction Schedule Updating: At intervals appropriate to the stage of construction, but no less than monthly, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate final completion percentage for each activity.

G. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.

H. Distribution: Distribute copies of approved schedule to Architect Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

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

1.8 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

A. CPM Schedule: Prepare Contractor's construction schedule using a time-scaled CPM network analysis diagram for the Work.

1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 60 days after date established for commencement of the Work.

    a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.

2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule in order to coordinate with the Contract Time.

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

1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:

    a. Preparation and processing of submittals.
    b. Mobilization and demobilization.
    c. Purchase of materials.
    d. Delivery.
    e. Fabrication.
    f. Utility interruptions.
    g. Installation.
    h. Work by Owner that may affect or be affected by Contractor's activities.
    i. Testing and inspection.
    j. Commissioning.
    k. Punch list and final completion.
    l. Activities occurring following final completion.

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

    a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.

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

D. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:

1. Contractor or subcontractor and the Work or activity.
2. Description of activity.
3. Main events of activity.
4. Immediate preceding and succeeding activities.
5. Early and late start dates.
6. Early and late finish dates.
7. Activity duration in workdays.
8. Total float or slack time.
9. Average size of workforce.
10. Dollar value of activity (coordinated with the schedule of values).

E. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:

1. Identification of activities that have changed.
2. Changes in early and late start dates.
3. Changes in early and late finish dates.
4. Changes in activity durations in workdays.
5. Changes in the critical path.
6. Changes in total float or slack time.
7. Changes in the Contract Time.

1.9 REPORTS

A. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013200

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

B. Related Requirements:

1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 013100 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
3. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
4. Section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
5. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
6. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
7. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
8. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.
9. Section 018113 “Sustainable Design Requirements” for submitting sustainable design data.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Business Day: The term “business day” shall mean working day, excluding weekends and legal holidays.

C. Day: The term "day" as used in this Section shall mean calendar day, including weekends and legal holidays.

D. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.4 SUBMITTAL PERFORMANCE REQUIREMENTS

A. Submittal Schedule: The General Contractor and Trade Contractors shall prepare a submittal schedule, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, and shall submit the schedule(s) for the Architect's approval. The submittal schedule shall be Coordinated with the Contractor's construction schedule and shall allow the Architect reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

B. Submittal Review: The General Contractor and Trade Contractors shall review for compliance with the Contract Documents, approve and submit to the Architect Shop Drawings, Product Data, Samples, and similar submittals required by the Contract Documents in accordance with the submittal schedule approved by the Architect, or, in the absence of an approved submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work while allowing sufficient time in the Architect's professional judgment to permit adequate review.

C. By submitting Shop Drawings, Product Data, Samples, and similar submittals, the General Contractor and Trade Contractors represent to the Owner and Architect that the General Contractor and Trade Contractors have:

1. Reviewed and approved them,
2. Determined and verified materials, field measurements and field conditions criteria related thereto, or will do so, and
3. Checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

D. Deviations: The Work shall be in accordance with the approved submittals except that the Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Architect’s review of Shop Drawings, Product Data, Samples, or other similar submittals unless the Contractor has specifically informed the Architect in writing of such deviation at the time of the submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar submittals by the Architect’s review thereof.

1.5 SUBMITTAL SCHEDULE

A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.

    a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.

4. Format: Arrange the following information in a tabular format:

    a. Scheduled date for first submittal.
    b. Specification Section number and title.
    c. Submittal Category: Action; informational.
    d. Name of subcontractor.
    e. Description of the Work covered.
    f. Scheduled date for Architect's final release or approval.
    g. Scheduled dates for purchasing.
    h. Scheduled date of fabrication.
    i. Scheduled dates for installation.
    j. Activity or event number.

1.6 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Architect.
4. Name of Construction Manager.
5. Name of Contractor.
6. Name of firm or entity that prepared submittal.
7. Names of subcontractor, manufacturer, and supplier.
8. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier; and alphanumeric suffix for resubmittals.
9. Category and type of submittal.
10. Submittal purpose and description.
11. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
12. Drawing number and detail references, as appropriate.
13. Indication of full or partial submittal.
14. Location(s) where product is to be installed, as appropriate.
15. Other necessary identification.
16. Remarks.
17. Signature of transmitter.

B. Options: Identify options requiring selection by Architect.

C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

D. Paper Submittals:

1. Provide paper copies of submittals to Owner upon request.
2. Submit no less than four paper copies of the following submittals to the Architect for review:

a. Coordination drawings per Section 013100 “Project Management and Coordination.”
b. Structural steel shop drawings.
c. When requested by Architect/Engineer.

E. PDF Submittals: Unless otherwise indicated, provide submittals in PDF format. Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

F. Submittals for Web-Based Project Software: Prepare submittals as PDF files, or other format indicated by Project software website.

1.7 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Email: Prepare submittals as PDF package, and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect.

a. Architect will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.

2. Web-Based Project Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.

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

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections so processing will not be delayed because of need to review submittals concurrently for coordination.

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

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

1. Initial Review: Allow 10 business days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 10 business days for review of each resubmittal.
4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 15 business days for initial review of each submittal.
5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 business days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.
6. Expedited Review: Subject to Architect’s agreement to Contractor’s request to expedite a submittal review, Contractor shall allow no less than 5 business days for such expedited review.

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

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

1.8 SUBMITTAL REQUIREMENTS

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

1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.

3. Include the following information, as applicable:

    a. Manufacturer's catalog cuts.
    b. Manufacturer's product specifications.
    c. Standard color charts.
    d. Statement of compliance with specified referenced standards.
    e. Testing by recognized testing agency.
    f. Application of testing agency labels and seals.
    g. Notation of coordination requirements.
    h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

    a. Wiring diagrams that show factory-installed wiring.
    b. Printed performance curves.
    c. Operational range diagrams.
    d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before Shop Drawings, and before or concurrent with Samples.

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

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

    a. Identification of products.
    b. Schedules.
    c. Compliance with specified standards.
    d. Notation of coordination requirements.
    e. Notation of dimensions established by field measurement.
    f. Relationship and attachment to adjoining construction clearly indicated.
    g. Seal and signature of professional engineer if specified.

2. Paper Sheet Size: Except for templates, patterns, and similar full-size Drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.

3. Submit Shop Drawings in the following format unless otherwise indicated:

    a. PDF electronic file, either through web-based project software or email.

4. BIM Incorporation: For Trade Contractors engaged as part of a design/build component of the Work and/or a component of the Work that is part of a Deferred Approval, develop and incorporate Shop Drawings into Building Information Model established for Project.

    a. Prepare Shop Drawings in the following format: Same digital data software program, version, and operating system as Architect's original Drawings.
    b. Refer to Section 013100 "Project Management and Coordination" for requirements for coordination drawings.

C. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other materials.

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

    a. Project name and submittal number.
    b. Generic description of Sample.

c. Product name and name of manufacturer.
d. Sample source.
e. Number and title of applicable Specification Section.
f. Specification paragraph number and generic name of each item.

3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics, and identification information for record.
4. Web-Based Project Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
5. Paper Transmittal: Include paper transmittal including complete submittal information indicated.
6. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

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

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

    a. Number of Samples: Submit no less than three (3) full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.

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

    a. Number of Samples: Submit no less than three (3) sets of Samples. Architect will retain one Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.

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

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

1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
2. Manufacturer and product name, and model number if applicable.
3. Number and name of room or space.
4. Location within room or space.
5. Submit product schedule in the following format:

    a. PDF electronic format.

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

F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

G. Certificates:

1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
2. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
4. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
5. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

H. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

    a. Name of evaluation organization.
    b. Date of evaluation.
    c. Time period when report is in effect.
    d. Product and manufacturers' names.
    e. Description of product.
    f. Test procedures and results.
    g. Limitations of use.

1.9 DELEGATED-DESIGN SERVICES – “DEFERRED APPROVALS”

A. General: Deferred submittals of required building permit application materials: Before issuing a Building Permit, the Building Official may allow deferral of submittal documents relating to a specific portion of the design. The Building Official shall specify a maximum time period for submittal of the deferred documents. The Building Permit for non-deferred portion may be issued and construction may start on the non-deferred portion of the Work, before the deferred submittals are submitted. The deferred submittal items shall not be installed until their design and submittal documents have been approved by the Building Official:

1. Comply with the requirements of all Authorities Having Jurisdiction. See the title sheet of the Drawings for additional information.
2. Submittal documents for deferred approval items shall be transmitted to the Building Official for review only after the Architect (and Architect’s consultant) action stamp(s) indicate “No Exceptions Taken.”

B. Submittal documents for deferred approval items shall be stamped and signed by a design professional licensed in the State of California. Submittal documents which have not been stamped and signed by a licensed design professional will be automatically returned to the Contractor with the Architect’s action stamp indicating “Revise and Resubmit.”

C. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

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

D. Delegated-Design Services: In addition to Shop Drawings, Product Data, and other required submittals, submit copies of a statement, signed and sealed by the responsible design professional, for each portion and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.
2. The responsible design professional shall be licensed in the State of California.

E. BIM Incorporation: Incorporate delegated-design drawing and data files into BIM established for Project.

1. Prepare delegated-design drawings in the following format: Same digital data software program, version, and operating system as original Drawings.

1.10 CONTRACTOR'S REVIEW

A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp indication in web-based Project software. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

1.11 ARCHITECT'S REVIEW

A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action, as follows:

1. Work covered by the submittal may proceed provided it complies with the Architect and Engineer's notations, corrections, and the Contract Documents. Final acceptance will depend on that compliance. Actions are as follows:

a. No Exceptions Taken.
b. Note Markings / Confirm.

2. Work covered by the submittal may NOT proceed. Revise or prepare a new submittal according to Architect or Engineer's notations and corrections and that complies with the Contract Documents. Actions are as follows:

a. Revise and Resubmit.
b. Incomplete – Resubmit.
c. Rejected.

3. Received for Record.
4. Submittal Not Required – Returned without Review.

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

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Architect will discard submittals received from sources other than Contractor.

F. The Architect's review of Contractor's submittals will be limited to examination of an initial submittal and one (1) resubmittal. The Owner is entitled to obtain reimbursement from the Contractor for amounts paid to the Architect for evaluation of additional resubmittals.

G. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013300

CONTRACTOR SUBMITTAL CHECKLIST

This Contractor Submittal Checklist must be acknowledged and signed by the General Contractor and Subcontractor and submitted with every submittal (located behind the Subcontractor transmittal). Submittals without this Submittal Checklist may be returned to the Contractor for completion and not forwarded for review. Check each box and provide information where requested.

SPEC SECTION	SUBMITTAL TITLE	COMPANY NAME

REVIEW AND PACKAGING:

- ☐ I have read the Contract Documents, including the associated specification section for this submittal.
- ☐ I have included in this submittal a marked up copy of the associated specification section. See following items for instructions.
- ☐ This submittal only includes product(s) from the associated specification section (One submittal per specification section).
- ☐ I have indicated in the attached specification by circling, which items are included in this submittal.
- ☐ I have indicated in the attached specification by notation, which items will be included in a future submittal by noting: "future submittal", "Will submit with Closeout Documents" or the like.
- ☐ I have indicated in the attached specification by crossing out, items which will not be included and notated as such as "by others", "not in project", etc.
- ☐ I have indicated in the attached specification by circling, the manufacturer submitted (if applicable).
- ☐ I have indicated in the attached specification by crossing out, manufactures not submitted.
- ☐ If the submittal is being made for consideration as an "or equal" / "or comparable equal" where permitted, I have complied with the additional requirements in Section 016000 "Product Requirements" and included this information in the submittal.
- ☐ If the submittal is being made as a "substitution for cause" where permitted, I have complied with the additional requirements of Section 012500 "Substitution Procedures" and included this information in the submittal. (Substitutions for convenience will not be considered.)
- ☐ I have added comments (if needed) to clarify expected execution of the work (acknowledge, cross out, or comment as applicable).
- ☐ All deviations, if any, from the Contract Documents are clearly identified in the submittal package.
- ☐ Product data submittal is organized in accordance with the specification section numbering. Associated specification section is referenced in the upper right hand corner of each product data sheet.
- ☐ If product data sheet contains several items, the specific items proposed for use on this project are notated by circling or arrows. (Do not use yellow/color highlighter; submittals must maintain clarity when copied in black and white.)
- ☐ Product literature submitted is clean and legible. Do not submit "copies of copies of copies" that will not maintain clarity when copied.
- ☐ I have reviewed the plans and the associated details specific to this submittal. Submittal and/or Shop Drawings included in this submittal are project specific and reference applicable Contract Document details.
- ☐ I have provided and electronic submittal in pdf format, with all submittal contents packaged in one file. Multiple files are not acceptable.
- ☐ Where required per the Contract Documents, I have provided a complete hard copy submittal, loosely bound and ready for scanning. Notebooks and specialty binds are not required.
- ☐ All samples are labeled or identified by stickers, labels or other means.

COORDINATION:

- ☐ On Contractor transmittal, identify activities (if any) that must take place prior to fabrication or purchase of items submitted (approval of samples, coordination with other trades or products, field measuring, etc.).

OTHER CONCERNS:

- ☐ On Contractor transmittal identify any other concerns or comments needing addressing by CM, Architect, Owner or others.

DEFERRED APPROVALS:

- ☐ Where portions of the Work are identified as being a "Deferred Approval," I have complied with the "Deferred Approval" requirements indicated in the Contract Documents, including, but not limited to, having a qualified California-licensed professional engineer stamp and sign the submittal documents.

The Contractor has reviewed and approved not only the field dimensions (when applicable) but the construction criteria and has also made written notation regarding any information in the submittal/shop drawings that does not conform to the Project Documents. This submittal/shop drawing has been coordinated with all other submittals/shop drawings received today by Contractor and this duty of coordination has not been delegated to sub-tier contractors, material suppliers, the ARCHITECT, or the engineers on this project.

Authorized Signature of Subcontractor and Company Name	Date
General Contractor	Date

SECTION 013516 - ALTERATION PROJECT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes special procedures for alteration work at existing building(s).

1.3 DEFINITIONS

A. Alteration Work: This term includes remodeling, renovation, repair, and maintenance work performed within existing spaces or on existing surfaces as part of the Project.

B. Consolidate: To strengthen loose or deteriorated materials in place.

C. Design Reference Sample: A sample that represents the Architect's prebid selection of work to be matched; it may be existing work or work specially produced for the Project.

D. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

E. Match: To blend with adjacent construction and manifest no apparent difference in material type, species, cut, form, detail, color, grain, texture, or finish; as approved by Architect.

F. Refinish: To remove existing finishes to base material and apply new finish to match original, or as otherwise indicated.

G. Repair: To correct damage and defects, retaining existing materials, features, and finishes. This includes patching, piecing-in, splicing, consolidating, or otherwise reinforcing or upgrading materials.

H. Replace: To remove, duplicate, and reinstall entire item with new material. The original item is the pattern for creating duplicates unless otherwise indicated.

I. Replicate: To reproduce in exact detail, materials, and finish unless otherwise indicated.

J. Reproduce: To fabricate a new item, accurate in detail to the original, and from either the same or a similar material as the original, unless otherwise indicated.

K. Retain: To keep existing items that are not to be removed or dismantled.

L. Strip: To remove existing finish down to base material unless otherwise indicated.

1.4 COORDINATION

A. Alteration Work Subschedule: A construction schedule coordinating the sequencing and scheduling of alteration work for entire Project, including each activity to be performed, and based on Contractor's Construction Schedule. Secure time commitments for performing critical construction activities from separate entities responsible for alteration work.

1. Schedule construction operations in sequence required to obtain best Work results.
2. Coordinate sequence of alteration work activities to accommodate the following:

    a. Owner's partial occupancy of completed Work.
    b. Other known work in progress.
    c. Tests and inspections.

3. Detail sequence of alteration work, with start and end dates.
4. Utility Services: Indicate how long utility services will be interrupted. Coordinate shutoff, capping, and continuation of utility services.
5. Use of elevator and stairs.
6. Equipment Data: List gross loaded weight, axle-load distribution, and wheel-base dimension data for mobile and heavy equipment proposed for use in existing structure. Do not use such equipment without certification from Contractor's professional engineer that the structure can support the imposed loadings without damage.

B. Pedestrian and Vehicular Circulation: Coordinate alteration work with circulation patterns within Project building(s) and site. Some work is near circulation patterns outside of the limits of work and/or restricted areas. Circulation patterns cannot be closed off entirely and in places can be only temporarily redirected around small areas of work. Access to restricted areas may not be obstructed. Plan and execute the Work accordingly.

1.5 PROJECT MEETINGS FOR ALTERATION WORK

A. Preliminary Conference for Alteration Work: Before starting alteration work, conduct conference at Project site.
1. Agenda: Discuss items of significance that could affect progress of alteration work, including review of the following:

    a. Alteration Work Subschedule: Discuss and finalize; verify availability of materials, specialists' personnel, equipment, and facilities needed to make progress and avoid delays.
    b. Fire-prevention plan.
    c. Governing regulations.
    d. Areas where existing construction is to remain and the required protection.
    e. Hauling routes.
    f. Sequence of alteration work operations.
    g. Storage, protection, and accounting for salvaged and specially fabricated items.
    h. Existing conditions, staging, and structural loading limitations of areas where materials are stored.
    i. Qualifications of personnel assigned to alteration work and assigned duties.
    j. Requirements for extent and quality of work, tolerances, and required clearances.
    k. Embedded work such as flashings and lintels, special details, collection of waste, protection of occupants and the public, and condition of other construction that affects the Work or will affect the work.

2. Reporting: Contractor shall record conference results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from conference.

B. Coordination Meetings: Conduct coordination meetings specifically for alteration work at intervals appropriate to the stage of construction. Coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.

1. Attendees: In addition to representatives of Owner, Construction Manager, Architect, and Contractor, each specialist, supplier, installer, and other entity concerned with progress or involved in planning, coordination, or performance of alteration work activities shall be represented at these meetings. All participants at conference shall be familiar with Project and authorized to conclude matters relating to alteration work.
2. Agenda: Review and correct or approve minutes of previous coordination meeting. Review other items of significance that could affect progress of alteration work. Include topics for discussion as appropriate to status of Project.

    a. Alteration Work Subschedule: Review progress since last coordination meeting. Determine whether each schedule item is on time, ahead of schedule, or behind schedule. Determine how construction behind schedule will be expedited with retention of quality; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities are completed within the Contract Time.
    b. Schedule Updating: Revise Contractor's Alteration Work Subschedule after each coordination meeting where revisions to schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
    c. Review present and future needs of each entity present, including review items listed in the "Preliminary Conference for Alteration Work" Paragraph in this article and the following:

        1) Interface requirements of alteration work with other Project Work.
        2) Status of submittals for alteration work.
        3) Access to alteration work locations.
        4) Effectiveness of fire-prevention plan.
        5) Quality and work standards of alteration work.
        6) Change Orders for alteration work.

3. Reporting: Contractor shall record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.6 INFORMATIONAL SUBMITTALS

A. Alteration Work Subschedule:

1. Submit alteration work subschedule within 30 days of date established for commencement of alteration work.

B. Preconstruction Documentation: Show preexisting conditions of adjoining construction and site improvements that are to remain, including finish surfaces, that might be misconstrued as damage caused by Contractor's alteration work operations.

C. Alteration Work Program: Submit 30 days before work begins.

D. Fire-Prevention Plan: Submit 30 days before work begins.

1.7 QUALITY ASSURANCE

A. Field Supervisor Qualifications: Full-time supervisors with minimum 10 years' experienced with alteration work similar in nature, material, design, and extent to that indicated for this Project. Supervisors shall be on-site when alteration work begins and during its progress. Supervisors shall not be changed during Project except for causes beyond the control of the Contractor.

B. Alteration Work Program: Prepare a written plan for alteration work for whole Project, including each phase or process and protection of surrounding materials during operations. Show compliance with indicated methods and procedures specified in this and other Sections. Coordinate this whole-Project alteration work program with specific requirements of programs required in other alteration work Sections.

1. Dust and Noise Control: Include locations of proposed temporary dust- and noise-control partitions and means of egress from occupied areas coordinated with continuing on-site operations and other known work in progress.
2. Debris Hauling: Include plans clearly marked to show debris hauling routes, turning radii, and locations and details of temporary protective barriers.

C. Fire-Prevention Plan: Prepare a written plan for preventing fires during the Work, including placement of fire extinguishers, fire blankets, rag buckets, and other fire-control devices during each phase or process. Coordinate plan with Owner's fire-protection equipment and requirements. Include fire-watch personnel's training, duties, and authority to enforce fire safety.

D. Safety and Health Standard: Comply with ANSI/ASSE A10.6.

1.8 STORAGE AND HANDLING OF SALVAGED MATERIALS

A. Salvaged Materials:

1. Clean loose dirt and debris from salvaged items unless more extensive cleaning is indicated.
2. Pack or crate items after cleaning; cushion against damage during handling. Label contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

B. Salvaged Materials for Reinstallation:

1. Repair and clean items for reuse as indicated.
2. Pack or crate items after cleaning and repairing; cushion against damage during handling. Label contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment unless otherwise indicated. Provide connections, supports, and miscellaneous materials to make items functional for use indicated.

C. Existing Materials to Remain: Protect construction indicated to remain against damage and soiling from construction work. Where permitted by Architect, items may be dismantled and taken to a suitable, protected storage location during construction work and reinstalled in their original locations after alteration and other construction work in the vicinity is complete.

D. Storage: Catalog and store items within a weathertight enclosure where they are protected from moisture, weather, condensation, and freezing temperatures.

1. Identify each item for reinstallation with a nonpermanent mark to document its original location. Indicate original locations on plans, elevations, sections, or photographs by annotating the identifying marks.
2. Secure stored materials to protect from theft.
3. Control humidity so that it does not exceed 85 percent. Maintain temperatures 5 deg F or more above the dew point.

E. Storage Space:

1. Owner will arrange for limited on-site location(s) for free storage of salvaged material.
2. Arrange for off-site locations for storage and protection of salvaged material that cannot be stored and protected on-site.

1.9 FIELD CONDITIONS

A. Survey of Existing Conditions: Record existing conditions that affect the Work by use of measured drawings, preconstruction photographs, and preconstruction videotapes.

B. Discrepancies: Notify Architect of discrepancies between existing conditions and Drawings before proceeding with removal and dismantling work.

C. Owner's Removals: Before beginning alteration work, verify in correspondence with Owner that Owner's items and items indicated to be salvaged have been removed:

D. Size Limitations in Existing Spaces: Materials, products, and equipment used for performing the Work and for transporting debris, materials, and products shall be of sizes that clear surfaces within existing spaces, areas, rooms, and openings, including temporary protection, by 12 inches or more.

PART 2 - PRODUCTS - (Not Used)

PART 3 - EXECUTION

3.1 PROTECTION

A. Protect persons, motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm resulting from alteration work.

1. Use only proven protection methods, appropriate to each area and surface being protected.
2. Provide temporary barricades, barriers, and directional signage to exclude the public from areas where alteration work is being performed.
3. Erect temporary barriers to form and maintain fire-egress routes.
4. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during alteration work.
5. Contain dust and debris generated by alteration work, and prevent it from reaching the public or adjacent surfaces.
6. Provide shoring, bracing, and supports as necessary. Do not overload structural elements.
7. Protect floors and other surfaces along hauling routes from damage, wear, and staining.
8. Provide supplemental sound-control treatment to isolate demolition work from other areas of the building.

B. Temporary Protection of Materials to Remain:

1. Protect existing materials with temporary protections and construction. Do not remove existing materials unless otherwise indicated.
2. Do not attach temporary protection to existing surfaces except as indicated as part of the alteration work program.

C. Comply with each product manufacturer's written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.

D. Utility and Communications Services:

1. Notify Owner, Architect, authorities having jurisdiction, and entities owning or controlling wires, conduits, pipes, and other services affected by alteration work before commencing operations.
2. Disconnect and cap pipes and services as required by authorities having jurisdiction, as required for alteration work.
3. Maintain existing services unless otherwise indicated; keep in service, and protect against damage during operations. Provide temporary services during interruptions to existing utilities.

E. Existing Drains: Prior to the start of work in an area, test drainage system to ensure that it is functioning properly. Notify Architect immediately of inadequate drainage or blockage. Do not begin work in an area until the drainage system is functioning properly.

1. Prevent solids such as adhesive or mortar residue or other debris from entering the drainage system. Clean out drains and drain lines that become sluggish or blocked by sand or other materials resulting from alteration work.
2. Protect drains from pollutants. Block drains or filter out sediments, allowing only clean water to pass.

F. Existing Roofing: Prior to the start of work in an area, install roofing protection.

3.2 PROTECTION FROM FIRE

A. General: Follow fire-prevention plan and the following:

1. Comply with NFPA 241 requirements unless otherwise indicated.
2. Remove and keep area free of combustibles, including rubbish, paper, waste, and chemicals, unless necessary for the immediate work.

B. Heat-Generating Equipment and Combustible Materials: Comply with the following procedures while performing work with heat-generating equipment or combustible materials, including welding, torch-cutting, soldering, brazing, removing paint with heat, or other operations where open flames or implements using high heat or combustible solvents and chemicals are anticipated:

1. Obtain Owner's approval for operations involving use of welding or other high-heat equipment. Notify Owner at least 72 hours before each occurrence, indicating location of such work.
2. As far as practicable, restrict heat-generating equipment to shop areas or outside the building.
3. Do not perform work with heat-generating equipment in or near rooms or in areas where flammable liquids or explosive vapors are present or thought to be present. Use a combustible gas indicator test to ensure that the area is safe.
4. Use fireproof baffles to prevent flames, sparks, hot gases, or other high-temperature material from reaching surrounding combustible material.
5. Prevent the spread of sparks and particles of hot metal through open windows, doors, holes, and cracks in floors, walls, ceilings, roofs, and other openings.
6. Fire Watch: Before working with heat-generating equipment or combustible materials, station personnel to serve as a fire watch at each location where such work is performed. Fire-watch personnel shall have the authority to enforce fire safety. Station fire watch according to NFPA 51B, NFPA 241, and as follows:

    a. Train each fire watch in the proper operation of fire-control equipment and alarms.
    b. Prohibit fire-watch personnel from other work that would be a distraction from fire-watch duties.
    c. Cease work with heat-generating equipment whenever fire-watch personnel are not present.
    d. Have fire-watch personnel perform final fire-safety inspection each day beginning no sooner than 30 minutes after conclusion of work in each area to detect hidden or smoldering fires and to ensure that proper fire prevention is maintained.
    e. Maintain fire-watch personnel at each area of Project site until 60 minutes after conclusion of daily work.
    f. If fire alarm system is in an inoperable condition, or if a floor is not being monitored due to construction, whether it is smoke detection or fire suppression, Contractor shall provide a fire watch for the construction area.

C. Fire-Control Devices: Provide and maintain fire extinguishers, fire blankets, and rag buckets for disposal of rags with combustible liquids. Maintain each as suitable for the type of fire risk in each work area. Ensure that nearby personnel and the fire-watch personnel are trained in fire-extinguisher and blanket use.

D. Sprinklers: Where sprinkler protection exists and is functional, maintain it without interruption while operations are being performed. If operations are performed close to sprinklers, shield them temporarily with guards.

1. Remove temporary guards at the end of work shifts, whenever operations are paused, and when nearby work is complete.

3.3 PROTECTION DURING APPLICATION OF CHEMICALS

A. Protect motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm or spillage resulting from applications of chemicals and adhesives.

B. Cover adjacent surfaces with protective materials that are proven to resist chemicals selected for Project unless chemicals being used will not damage adjacent surfaces as indicated in alteration work program. Use covering materials and masking agents that are waterproof and UV resistant and that will not stain or leave residue on surfaces to which they are applied. Apply protective materials according to manufacturer's written instructions. Do not apply liquid masking agents or adhesives to painted or porous surfaces. When no longer needed, promptly remove protective materials.

C. Do not apply chemicals during winds of sufficient force to spread them to unprotected surfaces.

D. Neutralize alkaline and acid wastes and legally dispose of off Owner's property.

E. Collect and dispose of runoff from chemical operations by legal means and in a manner that prevents soil contamination, soil erosion, undermining of paving and foundations, damage to landscaping, or water penetration into building interior.

3.4 GENERAL ALTERATION WORK

A. Ensure that supervisory personnel are present when work begins and during its progress.

B. Record existing work before each procedure (preconstruction), and record progress during the work. Use digital preconstruction documentation photographs.

C. Perform surveys of Project site as the Work progresses to detect hazards resulting from alterations.

D. Notify Architect of visible changes in the integrity of material or components whether from environmental causes including biological attack, UV degradation, freezing, or thawing or from structural defects including cracks, movement, or distortion.

1. Do not proceed with the work in question until directed by Architect.

END OF SECTION 013516

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
4. Specific test and inspection requirements are not specified in this Section.

C. Related Requirements:

1. Divisions 2 through 33 Sections for specific test and inspection requirements.

1.3 DEFINITIONS

A. Experienced: When used with an entity or individual, "experienced" unless otherwise further described means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

B. Field Quality-Control Tests: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.

1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

D. Mockups: Full-size physical assemblies that are constructed on-site either as freestanding temporary built elements or as part of permanent construction. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

1. Laboratory Mockups: Full-size physical assemblies constructed and tested at testing facility to verify performance characteristics.
2. Integrated Exterior Mockups: Mockups of the exterior envelope constructed on-site as freestanding temporary built elements, consisting of multiple products, assemblies, and subassemblies.

E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.

F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

G. Source Quality-Control Tests: Tests and inspections that are performed at the source; for example, plant, mill, factory, or shop.

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect.

1.4 DELEGATED-DESIGN SERVICES (“DEFERRED APPROVALS”)

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

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

1.5 CONFLICTING REQUIREMENTS

A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements are specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for direction before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

C. Conflicts: All conflicts in the Contract Documents shall be reported to the Architect in writing before proceeding with the Work affected thereby. Notwithstanding the order of precedence provisions set forth in the General Conditions, in the event of conflict between any of the Contract Documents, the provisions placing a more stringent requirement or greater burden on the Contractor or requiring the greater quantity or higher quality material or workmanship shall prevail, unless otherwise directed by the Architect in writing. In no event shall the Contract Documents relieve the Contractor from compliance with applicable laws and codes.

1.6 ACTION SUBMITTALS

A. Shop Drawings: For integrated exterior mockups.

1. Include plans, sections, and elevations, indicating materials and size of mockup construction.
2. Indicate manufacturer and model number of individual components.
3. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

B. Delegated-Design Services Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.7 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Qualification Data: For Contractor's quality-control personnel.

C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:

1. Seismic-force-resisting system, designated seismic system, or component listed in the designated seismic system quality-assurance plan prepared by Architect.
2. Main wind-force-resisting system or a wind-resisting component listed in the wind-force-resisting system quality-assurance plan prepared by Architect.

D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.
4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

1.8 CONTRACTOR'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.

B. Quality-Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.

1. Project quality-control manager may also serve as Project superintendent.

C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:

1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."
3. Owner-performed tests and inspections indicated in the Contract Documents, including tests and inspections indicated to be performed by the Commissioning Authority.

E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.

F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.9 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

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

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

1.10 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements. See Division 2 through 34 Sections for additional qualification requirements.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. See Division 2 through 34 Sections for additional qualification requirements.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance. See Division 2 through 34 Sections for additional qualification requirements.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

1. Contractor responsibilities include the following:

a. Provide test specimens representative of proposed products and construction.
b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
c. Provide sizes and configurations of test assemblies, and mockups to adequately demonstrate capability of products to comply with performance requirements.
d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
f. When testing is complete, remove test specimens, assemblies, and mockups; do not reuse products on Project.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
2. Notify Architect at least five (5) business days in advance of dates and times when mockups will be constructed.
3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at Project.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Obtain Architect's approval of mockups before starting work, fabrication, or construction.

    a. Allow five (5) business days for initial review and each re-review of each mockup.

6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed unless otherwise indicated.

L. Integrated Exterior Mockups: Construct integrated exterior mockup as indicated on Drawings, or if not indicated, in accordance with approved Shop Drawings. Coordinate installation of exterior envelope materials and products for which mockups are required in individual Specification Sections, along with supporting materials. Comply with requirements in "Mockups" Paragraph.

M. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Specification Sections.

N. First Installation of Repetitive Building Materials: For repetitive building materials that do not require formal mockups, notify Architect no less than seven (7) calendar days in advance of the first installation of such building material.

1.11 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
2. Payment for these services will be made from testing and inspecting allowances, as authorized by Change Orders.
3. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.

    a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

D. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.

E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."

F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of Contractor's quality-control plan. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.

1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.12 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, as indicated in Statement of Special Inspections indicated on the Drawings, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

3.3 SCHEDULE OF TESTING AND INSPECTIONS

A. A. In conjunction with the “Summary of Special Inspection” and “Special Inspection Program” indicated on the drawings and other special inspections required by authorities having jurisdiction, coordinate with testing and inspection for the following:

Number	Description	Testing by:
1	Inspection of Fabricators: Where fabrication of structural load-bearing members and assemblies is being performed on the premises of a fabricator’s shop, special inspection of the fabricated items shall be required by CBC Section 1704.2.5	By Owner-retained testing agency
2	Steel Construction: Per CBC Section 1705.2, CBC Table 1705.2.3, and as indicated on the Drawings.	By Owner-retained testing agency
3	Concrete and Shotcrete Construction: Per CBC Section 1705.3, CBC Table 1705.3, and as indicated on the Drawings.	By Owner-retained testing agency
4	Masonry Construction: Per CBC Section 1705.4 and as indicated on the Drawings.	By Owner-retained testing agency
5	Wood Construction Per CBC Section 1705.5 and as indicated on the Drawings.	By Owner-retained testing agency
6	Soils: Per CBC Section 1705.6 and Table 1705.6 and as indicated on the Drawings.	By Owner-retained testing agency
7	Cast-in-Place Deep Foundations: Per CBC Section 1705.8 and Table 1705.8 and as indicated on the Drawings.	By Owner-retained testing agency
8	Sprayed Fire-Resistant Materials: Per CBC Section 1704.14.	By Owner-retained testing agency
9	Mastic and Intumescent Fire-Resistant Coatings: Per CBC Section1704.15	By Owner-retained testing agency
10	Exterior Insulation and Finish Systems (EIFS) Per CBC 1705.16 and as required by manufacturer’s ICC evaluation report.)	Not Applicable
11	Seismic Resistance: Per CBC 1705.12, the statement of special inspections shall include seismic requirements for the following cases and as indicated: a. The seismic-force-resisting systems in structures in accordance with CBC Sections 1705.12.1 through 1705.12.3 as applicable. b. Structural steel per CBC Section 1705.12.1 c. Structural wood per CBC Section 1705.12.2. d. Cold-formed steel framing per CBC Section 1705.12.3 e. Designated seismic systems per CBC Section 1705.12.4 f. Storage racks per CBC 1705.12.7. g. Architectural components: Per CBC 1705.12.5. See item 12 below. h. Mechanical and electrical components: Per CBC 1705.12.6. See item 13 below.	 By Owner-retained testing agency By Owner-retained testing agency By Owner-retained testing agency By Owner-retained testing agency By Owner-retained testing agency By Owner-retained testing agency By Owner-retained testing agency See Below See Below

12	Architectural Components: Periodic special inspection is required during the erection and fastening of: a. Exterior cladding (> 30 feet above grade) b. Interior and exterior nonbearing walls (>15 psf) c. Interior and exterior veneer (> 5psf) d. Acoustic ceiling suspension system, as required by manufacturer's ICC evaluation report e. Post-installed anchors (per CBC 1705.3 and/or applicable ICC evaluation reports. f. Exterior insulation and finish systems (per CBC 1408.6) g. Below-grade waterproofing (full-time inspection)	 By Owner-retained testing agency By Owner-retained testing agency By Owner-retained testing agency By Owner-retained testing agency By Owner-retained testing agency Not Applicable By Owner-retained testing agency
13	Mechanical and Electrical Components: Periodic special inspection of plumbing, mechanical, and electrical components shall be required for the following: a. Anchorage of electrical equipment for emergency and standby power systems in structures assigned to Seismic Design Category C, D, E, or F. b. Anchorage of other electrical equipment in structures assigned to Seismic Design Category E or F. c. Installation and anchorage of piping systems designed to carry hazardous materials and their associated mechanical units in structures assigned to Seismic Design Category C, D, E, or F. d. Installation and anchorage of ductwork designed to carry hazardous materials in structures assigned to Seismic Design Category C, D, E, or F. e. Installation and anchorage of vibration isolation systems in structures designed to Seismic Design Category C, D, E, or F where the approved construction documents require a nominal clearance of 1/4 inch or less between the equipment support frame and restraint.	 By Owner-retained testing agency By Owner-retained testing agency By Owner-retained testing agency By Owner-retained testing agency

END OF SECTION 014000

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."

C. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

D. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

E. "Reviewed": When used to convey Architect's action on Contractor's submittals, applications, and requests, "reviewed" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."

B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. AABC - Associated Air Balance Council; www.aabc.com.
2. AAMA - American Architectural Manufacturers Association; www.aamanet.org.
3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
7. ABMA - American Boiler Manufacturers Association; www.abma.com.
8. ACI - American Concrete Institute; (Formerly: ACI International); www.abma.com.
9. ACPA - American Concrete Pipe Association; www.concrete-pipe.org.
10. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
11. AF&PA - American Forest & Paper Association; www.afandpa.org.
12. AGA - American Gas Association; www.aga.org.
13. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
14. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
15. AI - Asphalt Institute; www.asphaltinstitute.org.
16. AIA - American Institute of Architects (The); www.aia.org.
17. AISC - American Institute of Steel Construction; www.aisc.org.
18. AISI - American Iron and Steel Institute; www.steel.org.
19. AITC - American Institute of Timber Construction; www.aitc-glulam.org.
20. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
21. ANSI - American National Standards Institute; www.ansi.org.
22. AOSA - Association of Official Seed Analysts, Inc.; www.aosaseed.com.
23. APA - APA - The Engineered Wood Association; www.apawood.org.
24. APA - Architectural Precast Association; www.archprecast.org.
25. API - American Petroleum Institute; www.api.org.
26. ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).
27. ARI - American Refrigeration Institute; (See AHRI).
28. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
29. ASCE - American Society of Civil Engineers; www.asce.org.
30. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
31. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
32. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
33. ASSE - American Society of Safety Engineers (The); www.asse.org.
34. ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.
35. ASTM - ASTM International; www.astm.org.
36. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
37. AWEA - American Wind Energy Association; www.awea.org.
38. AWI - Architectural Woodwork Institute; www.awinet.org.
39. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
40. AWPA - American Wood Protection Association; www.awpa.com.
41. AWS - American Welding Society; www.aws.org.
42. AWWA - American Water Works Association; www.awwa.org.
43. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
44. BIA - Brick Industry Association (The); www.gobrick.com.
45. BICSI - BICSI, Inc.; www.bicsi.org.
46. BIFMA - BIFMA International; (Business and Institutional Furniture Manufacturer's Association); www.bifma.org.
47. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.

48. BWF - Badminton World Federation; (Formerly: International Badminton Federation); www.bissc.org.
49. CDA - Copper Development Association; www.copper.org.
50. CEA - Canadian Electricity Association; www.electricity.ca.
51. CEA - Consumer Electronics Association; www.ce.org.
52. CFFA - Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
53. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
54. CGA - Compressed Gas Association; www.cganet.com.
55. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
56. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
57. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
58. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
59. CPA - Composite Panel Association; www.pbmdf.com.
60. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
61. CRRC - Cool Roof Rating Council; www.coolroofs.org.
62. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
63. CSA - Canadian Standards Association; www.csa.ca.
64. CSA - CSA International; (Formerly: IAS - International Approval Services); www.csa-international.org.
65. CSI - Construction Specifications Institute (The); www.csinet.org.
66. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
67. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.cti.org.
68. CWC - Composite Wood Council; (See CPA).
69. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
70. DHI - Door and Hardware Institute; www.dhi.org.
71. ECA - Electronic Components Association; (See ECIA).
72. ECAMA - Electronic Components Assemblies & Materials Association; (See ECIA).
73. ECIA - Electronic Components Industry Association; www.eciaonline.org.
74. EIA - Electronic Industries Alliance; (See TIA).
75. EIMA - EIFS Industry Members Association; www.eima.com.
76. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
77. ESD - ESD Association; (Electrostatic Discharge Association); www.esda.org.
78. ESTA - Entertainment Services and Technology Association; (See PLASA).
79. EVO - Efficiency Valuation Organization; www.evo-world.org.
80. FCI - Fluid Controls Institute; www.fluidcontrolsinstitute.org.
81. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
82. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
83. FM Approvals - FM Approvals LLC; www.fmglobal.com.
84. FM Global - FM Global; (Formerly: FMG - FM Global); www.fmglobal.com.
85. FRSA - Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.; www.floridaroof.com.
86. FSA - Fluid Sealing Association; www.fluidsealing.com.
87. FSC - Forest Stewardship Council U.S.; www.fscus.org.
88. GA - Gypsum Association; www.gypsum.org.
89. GANA - Glass Association of North America; www.glasswebsite.com.
90. GS - Green Seal; www.greenseal.org.
91. HI - Hydraulic Institute; www.pumps.org.
92. HI/GAMA - Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
93. HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
94. HPVA - Hardwood Plywood & Veneer Association; www.hpva.org.
95. HPW - H. P. White Laboratory, Inc.; www.hpwhite.com.
96. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
97. IAS - International Accreditation Service; www.iasonline.org.
98. IAS - International Approval Services; (See CSA).
99. ICBO - International Conference of Building Officials; (See ICC).
100. ICC - International Code Council; www.iccsafe.org.
101. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
102. ICPA - International Cast Polymer Alliance; www.icpa-hq.org.
103. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
104. IEC - International Electrotechnical Commission; http://www.iec.ch.

105. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
106. IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); www.ies.org.
107. IESNA - Illuminating Engineering Society of North America; (See IES).
108. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
109. IGMA - Insulating Glass Manufacturers Alliance; www.igmaonline.org.
110. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.okstate.edu.
111. ILI - Indiana Limestone Institute of America, Inc.; www.iliai.com.
112. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
113. ISA - International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); www.isa.org.
114. ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).
115. ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); www.isfanow.org.
116. ISO - International Organization for Standardization; www.iso.org.
117. ISSFA - International Solid Surface Fabricators Association; (See ISFA).
118. ITU - International Telecommunication Union; www.itu.int/home.
119. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
120. LMA - Laminating Materials Association; (See CPA).
121. LPI - Lightning Protection Institute; www.lightning.org.
122. MBMA - Metal Building Manufacturers Association; www.mbma.com.
123. MCA - Metal Construction Association; www.metalconstruction.org.
124. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
125. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
126. MHIA - Material Handling Industry of America; www.mhia.org.
127. MIA - Marble Institute of America; www.marble-institute.com.
128. MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.
129. MPI - Master Painters Institute; www.paintinfo.com.
130. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org.
131. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
132. NACE - NACE International; (National Association of Corrosion Engineers International); www.nace.org.
133. NADCA - National Air Duct Cleaners Association; www.nadca.com.
134. NAIMA - North American Insulation Manufacturers Association; www.naima.org.
135. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
136. NBI - New Buildings Institute; www.newbuildings.org.
137. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
138. NCMA - National Concrete Masonry Association; www.ncma.org.
139. NEBB - National Environmental Balancing Bureau; www.nebb.org.
140. NECA - National Electrical Contractors Association; www.necanet.org.
141. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
142. NEMA - National Electrical Manufacturers Association; www.nema.org.
143. NETA - InterNational Electrical Testing Association; www.netaworld.org.
144. NFHS - National Federation of State High School Associations; www.nfhs.org.
145. NFPA - National Fire Protection Association; www.nfpa.org.
146. NFPA - NFPA International; (See NFPA).
147. NFRC - National Fenestration Rating Council; www.nfrc.org.
148. NHLA - National Hardwood Lumber Association; www.nhla.com.
149. NLGA - National Lumber Grades Authority; www.nlga.org.
150. NOFMA - National Oak Flooring Manufacturers Association; (See NWFA).
151. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
152. NRCA - National Roofing Contractors Association; www.nrca.net.
153. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
154. NSF - NSF International; www.nsf.org.
155. NSPE - National Society of Professional Engineers; www.nspe.org.
156. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
157. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
158. NWFA - National Wood Flooring Association; www.nwfa.org.
159. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
160. PDI - Plumbing & Drainage Institute; www.pdionline.org.

161. PLASA - PLASA; (Formerly: ESTA - Entertainment Services and Technology Association); www.plasa.org.
162. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
163. RFCI - Resilient Floor Covering Institute; www.rfci.com.
164. RIS - Gene Theory Inspection Service; www.genetheoryinspection.com.
165. SAE - SAE International; www.sae.org.
166. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
167. SDI - Steel Deck Institute; www.sdi.org.
168. SDI - Steel Door Institute; www.steeldoor.org.
169. SEFA - Scientific Equipment and Furniture Association (The); www.sefalabs.com.
170. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
171. SIA - Security Industry Association; www.siaonline.org.
172. SJI - Steel Joist Institute; www.steeljoist.org.
173. SMA - Screen Manufacturers Association; www.smainfo.org.
174. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
175. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
176. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
177. SPIB - Southern Pine Inspection Bureau; www.spib.org.
178. SPRI - Single Ply Roofing Industry; www.spri.org.
179. SRCC - Solar Rating & Certification Corporation; www.solar-rating.org.
180. SSINA - Specialty Steel Industry of North America; www.ssina.com.
181. SSPC - SSPC: The Society for Protective Coatings; www.sspc.org.
182. STI - Steel Tank Institute; www.steeltank.com.
183. SWI - Steel Window Institute; www.steelwindows.com.
184. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
185. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
186. TCNA - Tile Council of North America, Inc.; www.tileusa.com.
187. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.
188. TIA - Telecommunications Industry Association (The); (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); www.tiaonline.org.
189. TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
190. TMS - The Masonry Society; www.masonrysociety.org.
191. TPI - Truss Plate Institute; www.tpinst.org.
192. TPI - Turfgrass Producers International; www.turfgrasssod.org.
193. TRI - Tile Roofing Institute; www.tileroofing.org.
194. UL - Underwriters Laboratories Inc.; www.ul.com.
195. UNI - Uni-Bell PVC Pipe Association; www.uni-bell.org.
196. USAV - USA Volleyball; www.usavolleyball.org.
197. USGBC - U.S. Green Building Council; www.usgbc.org.
198. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
199. WASTEC - Waste Equipment Technology Association; www.wastec.org.
200. WCLIB - West Coast Lumber Inspection Bureau; www.wclib.org.
201. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
202. WDMA - Window & Door Manufacturers Association; www.wdma.com.
203. WI - Woodwork Institute; www.wicnet.org.
204. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.
205. WWPA - Western Wood Products Association; www.wwpa.org.

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.

1. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
2. ICC - International Code Council; www.iccsafe.org.
3. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.

1. COE - Army Corps of Engineers; www.usace.army.mil.

2. CPSC - Consumer Product Safety Commission; www.cpsc.gov.
3. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
4. DOD - Department of Defense; www.quicksearch.dla.mil.
5. DOE - Department of Energy; www.energy.gov.
6. EPA - Environmental Protection Agency; www.epa.gov.
7. FAA - Federal Aviation Administration; www.faa.gov.
8. FG - Federal Government Publications; www.gpo.gov/fdsys.
9. GSA - General Services Administration; www.gsa.gov.
10. HUD - Department of Housing and Urban Development; www.hud.gov.
11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; www.eetd.lbl.gov.
12. OSHA - Occupational Safety & Health Administration; www.osha.gov.
13. SD - Department of State; www.state.gov.
14. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
16. USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.
17. USDOJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
18. USP - U.S. Pharmacopeial Convention; www.usp.org.
19. USPS - United States Postal Service; www.usps.com.

E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CFR - Code of Federal Regulations; Available from Government Printing Office; www.gpo.gov/fdsys.
2. DOD - Department of Defense; Military Specifications and Standards; Available from DLA Document Services; www.quicksearch.dla.mil.
3. DSCC - Defense Supply Center Columbus; (See FS).
4. FED-STD - Federal Standard; (See FS).
5. FS - Federal Specification; Available from DLA Document Services; www.quicksearch.dla.mil.
    a. Available from Defense Standardization Program; www.dsp.dla.mil.
    b. Available from General Services Administration; www.gsa.gov.
    c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org/ccb.
6. MILSPEC - Military Specification and Standards; (See DOD).
7. USAB - United States Access Board; www.access-board.gov.
8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).

F. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CALTRANS; State of California; Department of Transportation; www.dot.ca.gov.
2. CBHF; State of California; Department of Consumer Affairs; Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation; www.bearhfti.ca.gov.
3. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; www.calregs.com.
4. CDHS; California Department of Health Services; (See CDPH).
5. CDPH; California Department of Public Health; Indoor Air Quality Program; www.cal-iaq.org.
6. CPUC; California Public Utilities Commission; www.cpuc.ca.gov.
7. DSA; Division of the State Architect; www.dgs.ca.gov
8. SCAQMD; South Coast Air Quality Management District; www.aqmd.gov.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Requirements:

1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.
2. Section 321216 "Asphalt Paving" for construction and maintenance of asphalt pavement for temporary roads and paved areas.
3. Section 321313 "Concrete Paving" for construction and maintenance of cement concrete pavement for temporary roads and paved areas.

1.3 USE CHARGES

A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner, Owner's Agents, Owner's Consultants, Architect, Architect's Consultants, occupants of Project, testing agencies, and authorities having jurisdiction.

B. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

C. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.4 INFORMATIONAL SUBMITTALS

A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.

B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of environmental evaluation and/or authorities having jurisdiction, whichever is more stringent. Also comply with erosion and sediment control requirements defined on the civil engineering drawings.

C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

D. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold.

E. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:

1. Locations of dust-control partitions at each phase of work.
2. HVAC system isolation schematic drawing.
3. Location of proposed air-filtration system discharge.
4. Waste handling procedures.
5. Other dust-control measures.

1.5 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Moisture-Protection: Protect materials and construction from water absorption and damage. Protect during delivery, handling, and storage. Discard water-damaged materials, mitigate water intrusion into completed Work, and replace water damaged Work.

C. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

D. Accessible Temporary Egress: Comply with applicable provisions in the 2010 ADA Standards for Accessible Design and the accessibility requirements of the 2016 California Building Code.

E. Construction Support Facilities: Comply with applicable provisions in the 2016 California Building Code, including, but not limited to, Section 11B-201.4.

1.6 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pavement: Comply with applicable Division 32 Section(s).

B. Chain-Link Fencing: Minimum 2-inch, 0.148-inch-thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch-OD line posts and 2-7/8-inch-OD corner and pull posts, with 1-5/8-inch-OD top rails.

C. Portable Chain-Link Fencing: Minimum 2-inch, 0.148-inch-thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch-OD line posts and 2-7/8-inch-OD corner and pull posts, with 1-5/8-inch-OD top and bottom rails. Provide concrete or galvanized-steel bases for supporting posts.

D. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil minimum thickness, with flame-spread rating of 15 or less per ASTM E 84 and passing NFPA 701 Test Method 2.

E. Dust-Control Adhesive-Surface Walk-off Mats: Provide mats minimum 36 by 60 inches.

F. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

2.2 TEMPORARY FACILITIES

A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, Construction Manager, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:

1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
2. Conference room of sufficient size to accommodate meetings of no less than 12 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot-square tack and marker boards.
3. Drinking water and private toilet.
4. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
5. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction and clean HVAC systems as required in Section 017700 “Closeout Procedures.”

C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

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

3.2 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

1. Locate facilities to limit site disturbance as specified in Section 011000 "Summary."

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.3 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service.

1. Arrange with utility company for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.

1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.

C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.

F. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.

1. Prior to commencing work, isolate the HVAC system in area where work is to be performed.

a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
b. Maintain negative air pressure within work area using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.

2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.

G. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

1. Install electric power service overhead unless otherwise indicated.
2. Connect temporary service to Owner's existing power source, as directed by Owner.

H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

I. Telephone and Internet Service: Provide temporary telephone and Internet service in common-use facilities for use by all construction personnel. Install a minimum of one telephone line and one high-speed Internet service connection for each field office.

1. Provide field supervision with cellular telephone for use when away from field office.

3.4 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
2. Maintain support facilities until time of Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas within construction limits indicated on Drawings.

1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.

C. Temporary Use of Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.

1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Section 312000 "Earth Moving."
3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course according to Section 321216 "Asphalt Paving."

D. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

E. Parking Areas for Construction Personnel: Subject to Owner/Contractor agreement.

F. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations.

G. Project Signs: Provide Project signs as directed by Owner. Unauthorized signs are not permitted.

1. Identification Signs: Provide Project identification signs as directed by Owner.
2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.

    a. Provide temporary, directional signs for construction personnel and visitors.

3. Maintain and touchup signs so they are legible at all times.

H. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution." Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

I. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

J. Temporary Elevator Use: Use of existing elevators is not permitted for construction operations. Refer to Division 14 Section(s) for temporary use of new elevators.

K. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.

L. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

1. Comply with work restrictions specified in Section 011000 "Summary."

C. Temporary Erosion and Sedimentation Control: Comply with authorities having jurisdiction, other Section(s), and as indicated on the Drawings, whichever is more stringent.

D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

E. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.

F. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.

1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.

G. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.

H. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

I. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.

J. Covered Walkway: Where required by authorities having jurisdiction, erect protective, covered walkway for passage of individuals through or adjacent to Project site. Coordinate with entrance gates, other facilities, and obstructions.

1. Construct covered walkways using scaffold or shoring framing.
2. Provide overhead decking, protective enclosure walls, handrails, barricades, warning signs, exit signs, lights, safe and well-drained walkways, and similar provisions for protection and safe passage.
3. Paint and maintain appearance of walkway for duration of the Work.

K. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

L. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate finished and unfinished areas.

1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant-treated plywood on construction operations side.
2. Construct dustproof partitions with two layers of 6-mil polyethylene sheet on each side. Cover floor with two layers of 6-mil polyethylene sheet, extending sheets 18 inches up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant-treated plywood.

    a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches between doors. Maintain water-dampened foot mats in vestibule.

3. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
4. Insulate partitions to control noise transmission to occupied areas.
5. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
6. Protect air-handling equipment.
7. Provide walk-off mats at each entrance through temporary partition.

M. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.

1. Prohibit smoking in construction areas.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.6 MOISTURE AND MOLD CONTROL

A. Contractor's Moisture-Protection Plan: Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.

1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and gypsum board, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
3. Indicate methods to be used to avoid trapping water in finished work.

B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:

1. Protect porous materials from water damage.
2. Protect stored and installed material from flowing or standing water.
3. Keep porous and organic materials from coming into prolonged contact with concrete.
4. Remove standing water from decks.
5. Keep deck openings covered or dammed.

C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
2. Keep interior spaces reasonably clean and protected from water damage.
3. Periodically collect and remove waste containing cellulose or other organic matter.
4. Discard or replace water-damaged material.
5. Do not install material that is wet.
6. Discard, replace, or clean stored or installed material that begins to grow mold.
7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.

D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:

1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
2. Use permanent HVAC system to control humidity.
3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.

    a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective.
    b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
    c. Remove materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.7 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

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

1. Selection of products for use in Project.
2. Product delivery, storage, and handling.
3. Manufacturer’s standard warranties on products.
4. Special warranties.
5. Comparable products, being submitted for consideration as one of the following:

a. “Or Equal”
b. “Or Comparable Equal”

c. Complete "Request for Comparable Product" at end of this Section. Include documentation to indicate compliance with requirements specified in "Comparable Products" Article.

1) Architect will consider requests for comparable products if written request form and all of the supporting documentation and action submittals are complete and received by the Architect in a timely manner.
2) Requests for comparable products are subject to Owner and Architect approval. If comparable product request(s) are found to be not equivalent by the Owner and Architect, the request(s) may be rejected and the Contractor shall provide the specified product at no additional cost.
3) The Contractor's failure to obtain in a timely manner one of the specified products (e.g. a contractor-caused submittal delay, contractor did not take into consideration for long-lead time, etc.) is NOT considered a justifiable request for comparable product.

B. Related Requirements:

1. Section 012500 "Substitution Procedures" for requests for substitutions.

a. Substitutions for cause.
b. Substitutions for convenience.

2. Section 014200 "References" for applicable industry standards for products specified.

1.3 DEFINITIONS

A. Day: The term "day" as used in this Section shall mean calendar day, including weekends and holidays.

B. Business Day: The term “business day” shall mean working day, excluding weekends and legal holidays.

C. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
4. "Or Equal:" Term via which an unnamed product is being submitted for consideration as a comparable product. Comply with the requirements of this Section. Determination of whether or not the unnamed product meets the definition of comparable product will be made by the Owner and Architect.
5. "Or Comparable Equal:" Term via which an unnamed product is being submitted for consideration as a comparable product. Comply with requirements of this Section. Determination of whether or not the unnamed product meets the definition of comparable product will be made by the Owner and Architect.
6. Use of product(s) under the "Or Equal" / "Or Comparable Equal" provision shall not result in any delay in completion of the Work, including completion of portions of the Work for use by Owner or for work under separate contract by Owner.
7. Use of product(s) under the "or equal" / "or comparable equal" provision shall not result in change in Contract Sum and Contract Time. Should additional costs be incurred, including costs for redesign and for fees for plan check review and permit, costs shall be paid by Contractor with no change in Contract Sum and Contract Time.

D. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics.

E. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications. Submit a comparable product request, if applicable.

1.4 ACTION SUBMITTALS

A. Comparable Product Request Submittal: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Request for Comparable Product Form: Use "Request for Comparable Product" following this Section.
2. Documentation: Show compliance with the requirements in "Comparable Products" Article.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within 5 business days of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 10 business days of receipt of request, or 5 business days of receipt of additional information or documentation, whichever is later.

    a. Form of Approval: As specified in Section 013300 "Submittal Procedures."
    b. Comparable product requests must be approved in writing by the Owner, Architect, and as applicable Authorities Having Jurisdiction.
    c. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
    d. Provide specified product(s) when request for comparable product has been rejected.

B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 013300 "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.

1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.
2. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:

    a. Name of product and manufacturer.
    b. Model and serial number.
    c. Capacity.
    d. Speed.
    e. Ratings.

3. See individual identification sections in Divisions 21, 22, 23, and 26 for additional identification requirements.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.
7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Special Contractor Warranty for Comparable Products: Contractor warrants that comparable product or system will perform same as original specified material or system would have performed. Should accepted comparable product fail to perform as required, Contractor shall replace comparable product or system with that specified and bear costs incurred thereby.

D. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
7. Or Comparable Equal: For basis-of-design product specified by name and accompanied by the term “or comparable equal,” comply with “Comparable Products” Article to obtain approval for use of any of the other named products or for use of an unnamed product in lieu of the basis-of-design system.

B. Product Selection Procedures:

1. Sole-Source:

a. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
b. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
c. Sole-source is indicated by the phrase: "Subject to compliance with requirements, provide the following: …"

2. With a Basis-of-Design Product:

a. Basis-of-Design with Limited List of Manufacturers: Where Specifications name a basis-of-design product, or refer to a basis-of-design product indicated on Drawings, and include a limited list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, performance requirements, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other listed manufacturers. Comparable products by unlisted manufacturers will not be considered. Substitutions from unlisted manufacturers for Contractor convenience will not be considered.

1) Limited list of manufacturers is indicated by the phrase: "Basis-of-Design Product: Subject to compliance with requirements, provide the following … or a comparable product by one of the following…"

b. Basis-of-Design with Non-Limited List of Manufacturers: Where Specifications name a basis-of-design product, or refer to a basis-of-design product indicated on Drawings, and include a non-limited list of manufacturers, provide the specified or indicated product or a comparable product by one of the listed or unlisted manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, performance requirements, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other listed or unlisted manufacturers.

1) Non-limited list of manufacturers is indicated by the phrase: "Basis-of-Design Product: Subject to compliance with requirements, provide the following… or Comparable Equal."

c. Subject to the Architect's and/or Owner's review, requests for comparable products that do not meet the performance requirements and/or are not equivalent to the salient characteristics of the basis-of-design product may be rejected.

3. Without a Basis-of-Design Product:

a. Limited List:

1) Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Requests for comparable products by unlisted manufacturers or substitutions for Contractor's convenience will not be considered.

2) Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Requests for comparable products by unlisted manufacturers or substitutions for Contractor's convenience will not be considered.

3) Limited list is indicated by the phrase: "Subject to compliance with requirements, provide one of the following: …"

b. Non-Limited List:

1) Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, which complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by an unnamed manufacturer.

2) Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, which complies with requirements. Comply with requirements in “Comparable Products” Article for consideration of an unnamed product by an unnamed manufacturer.

3) Non-limited list is indicated by one of the following:

a) The phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated into the Work, include, but are not limited to, the following: …"
b) The phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following: …"
c) "Or Equal."

4) Subject to the Architect's and/or Owner's review, unlisted products or products by unlisted manufacturers that do not meet the performance requirements and/or are not equivalent to the listed manufacturers / listed products may be rejected.

C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration: Use "Request for Comparable Product" form following this Section. Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:

1. Documentation: Show compliance with requirements for comparable products and the following as applicable:

a. Executive Summary: In addition to the requirements noted above and below, provide an executive summary, which compares the significant technical properties and characteristics between the specified product(s) and the proposed comparable product(s). Such summary shall be limited to two pages, and shall be presented in a matrix or bullet format. Where visual or aesthetic criteria are a component of the comparison, provide samples of both the original product specified and the proposed comparable product.
b. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
c. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed comparable product. If proposed product involves more than one contractor, confirmation that proposed product has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

d. Evidence that the proposed product does not require revisions to the Contract Documents; that it is consistent with the Contract Documents and will produce the indicated results; and that it is compatible and will be coordinated with other portions of the Work
e. Detailed comparison of significant qualities of proposed comparable product with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.

    1) Include evidence that proposed product meets or exceeds the specified requirements and salient performance characteristics of the specified product or system. Include detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.

f. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
g. Warranty, provide evidence that comparable product provides specified warranty.
h. Evidence that proposed product is available in color(s) and finish(es) the same as specified product where product remains exposed to view.
i. Samples, where applicable or requested.
j. Certificates and qualification data, where applicable or requested.
k. If proposed product is part of a “Deferred Approval,” contractor shall maintain sole responsibility for obtaining professional design services; preparation of Submittals for such item(s) in a timely manner so as to not delay or hinder the completion of the Work within the Contract Time; and obtain necessary approval(s).
l. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
m. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
n. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
o. Sustainable design characteristics equal to or better than product(s) specified.
p. Detailed comparison of Contractor's construction schedule using proposed comparable product with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
q. Contractor's certification that proposed comparable product complies with requirements in the Contract Documents except as indicated in comparable product request, is compatible with related materials, and is appropriate for applications indicated.
r. The Owner shall be entitled to reimbursement from the Contractor for amounts paid to the Architect for reviewing the Contractor’s request for comparable products and making agreed-upon changes in the Drawings and Specifications resulting from such comparable products.
s. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed comparable product to produce indicated results

B. Review: Requests for comparable products are subject to Owner and Architect review and approval.

1. Proposed unnamed products that are being submitted for consideration as an “Or Equal” shall meet the requirements above and shall be equivalent in performance to the salient characteristics of the other listed products.
2. Proposed unnamed products that are being submitted for consideration as an “Or Comparable Equal” in lieu of a basis-of-design product shall meet the requirements above and shall be equivalent in performance to the salient characteristics of the basis-of-design system.

If comparable product request(s) are found by the Owner and Architect to be not equivalent to the specified product(s), the request(s) for consideration may be rejected and the Contractor shall provide the specified product(s) at no additional cost.

C. Submittal Requirements: Approval by the Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

REQUEST FOR COMPARABLE PRODUCT

Project: _____ Comparable Product Request Number: _____

_____ From: _____

To: _____ Date: _____

_____ A/E Project Number: _____

Re: _____ Contract For: _____

Specification Title: _____ Description: _____

Section: _____ Page: _____ Article/Paragraph: _____

Proposed Comparable Product: _____

Manufacturer: _____ Address: _____ Phone: _____

Trade Name: _____ Model No.: _____

Installer: _____ Address: _____ Phone: _____

History: ☐ New product ☐ 1-4 years old ☐ 5-10 years old ☐ More than 10 years old

Differences between proposed comparable product and specified product: _____

_____

_____

☐ Point-by-point comparative data attached — REQUIRED BY A/E

Reason for not providing specified item: _____

_____

Similar Installation: _____

_____ Architect: _____

Address: _____ Owner: _____

_____ Date Installed: _____

Proposed comparable product affects other parts of Work: ☐ No ☐ Yes; explain _____

_____

Savings to Owner for accepting comparable product: _____ ($).

Proposed comparable product changes Contract Time: ☐ No ☐ Yes [Add] [Deduct] _____ days.

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ _____

REQUEST FOR COMPARABLE PRODUCT

(Continued)

The Undersigned certifies:

- Proposed request for comparable product has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed comparable product as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed comparable product will have no adverse effect on other trades and will not affect or delay progress schedule.
- Cost data as stated above is complete. Claims for additional costs related to accepted comparable product which may subsequently become apparent are to be waived.
- Proposed comparable product does not affect dimensions and functional clearances.
- The Owner shall be entitled to reimbursement from the Contractor for amounts paid to Architect for reviewing the Contractor's request for comparable products and making agreed-upon changes in the Drawings and Specifications resulting from such comparable products.
- Coordination, installation, and changes in the Work as necessary for accepted comparable product will be complete in all respects.

Submitted by: _____

Signed by: _____

Firm: _____

Address: _____

_____

Telephone: _____

Attachments: ☐

A/E's REVIEW AND ACTION

☐ Comparable product – No Exceptions. Make submittals in accordance with Specification Section 013300 Submittal Procedures.
☐ Comparable product – Note Markings. Make submittals in accordance with Specification Section 013300 Submittal Procedures.
☐ Comparable product – Rejected. Use specified materials.
☐ Comparable product request received too late - Use specified materials.

Signed by: _____ Date: _____

Additional Comments: ☐ Contractor ☐ Subcontractor ☐ Supplier ☐ Manufacturer ☐ A/E
☐ Other:

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Coordination of Owner-installed products.
6. Progress cleaning.
7. Starting and adjusting.
8. Protection of installed construction.

B. Related Requirements:

1. Section 011000 "Summary" for limits on use of Project site.
2. Section 013300 "Submittal Procedures" for submitting surveys.
3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.
4. Section 024119 "Selective Demolition" for demolition and removal of selected portions of the building.
5. Section 078413 "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For land surveyor or professional engineer.

B. Certificates: Submit certificate signed by land surveyor or professional engineer certifying that location and elevation of improvements comply with requirements.

C. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:

1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
3. Products: List products to be used for patching and firms or entities that will perform patching work.
4. Dates: Indicate when cutting and patching will be performed.

5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.

    a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.

D. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

E. Certified Surveys: Submit two copies signed by land surveyor or professional engineer.

F. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.5 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection

2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:

    a. Primary operational systems and equipment.
    b. Fire separation assemblies.
    c. Air or smoke barriers.
    d. Fire-suppression systems.
    e. Plumbing piping systems.
    f. Mechanical systems piping and ducts.
    g. Control systems.
    h. Communication systems.
    i. Fire-detection and -alarm systems.
    j. Conveying systems.
    k. Electrical wiring systems.
    l. Operating systems of special construction.

3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:

    a. Water, moisture, or vapor barriers.
    b. Membranes and flashings.
    c. Exterior curtain-wall construction.
    d. Sprayed fire-resistive material.
    e. Equipment supports.
    f. Piping, ductwork, vessels, and equipment.
    g. Noise- and vibration-control elements and systems.

4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility and Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.

B. General: Engage a land surveyor or professional engineer to lay out the Work using accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish limits on use of Project site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
4. Inform installers of lines and levels to which they must comply.
5. Check the location, level and plumb, of every major element as the Work progresses.
6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

E. Final Property Survey: Engage a land surveyor or professional engineer to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor or professional engineer, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.

F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

J. Repair or remove and replace damaged, defective, or nonconforming Work.

1. Comply with Section 017700 "Closeout Procedures" for repairing or removing and replacing defective Work.

3.6 CUTTING AND PATCHING

A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

C. Temporary Support: Provide temporary support of work to be cut.

D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 011000 "Summary."

F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.

    a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

    a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 OWNER-INSTALLED PRODUCTS

A. Site Access: Provide access to Project site for Owner's construction personnel.

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.

1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.8 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

    a. Use containers intended for holding waste materials of type to be stored.

4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls" and Section 017419 "Construction Waste Management and Disposal."

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.9 STARTING AND ADJUSTING

A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 019113 "General Commissioning Requirements."

B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.10 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.

C. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

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

1. Salvaging nonhazardous demolition and construction waste.
2. Recycling nonhazardous demolition and construction waste.
3. Disposing of nonhazardous demolition and construction waste.
4. Include recycling and disposing of Owner's FF&E construction waste.

B. Related Requirements:

1. Section 018113 "Sustainable Design Requirements" for additional sustainable design requirements.
2. Section 024116 "Structure Demolition" for disposition of waste resulting from structure demolition.
3. Section 024119 "Selective Demolition" for disposition of waste resulting from partial demolition of buildings.

1.3 DEFINITIONS

A. CALGreen: 2016 California Green Building Standards Code.

B. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

C. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

D. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

E. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

F. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

G. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 PERFORMANCE REQUIREMENTS

A. Construction Waste Diversion: Recycle and/or salvage for reuse a minimum 65 percent of the nonhazardous construction and demolition waste in accordance with CALGReen Sections 5.408.1.1, 5.408.1.2, or 5.408.1.3, or meet a local construction and demolition waste management ordinance, whichever is more stringent. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials, including the following:

1. Demolition Waste:

    a. Concrete.
    b. Concrete reinforcing steel.
    c. Concrete masonry units.
    d. Wood studs.
    e. Wood joists.
    f. Plywood and oriented strand board.
    g. Wood paneling.
    h. Wood trim.
    i. Structural and miscellaneous steel.
    j. Rough hardware.
    k. Roofing.
    l. Insulation.
    m. Doors and frames.
    n. Door hardware.
    o. Metal studs.
    p. Gypsum board.
    q. Acoustical tile and panels.
    r. Carpet.
    s. Carpet pad.
    t. Equipment.
    u. Cabinets.
    v. Plumbing fixtures.
    w. Piping.
    x. Supports and hangers.
    y. Valves.
    z. Sprinklers.
    aa. Mechanical equipment.
    bb. Refrigerants.
    cc. Electrical conduit.
    dd. Copper wiring.
    ee. Lighting fixtures.
    ff. Lamps.
    gg. Ballasts.
    hh. Electrical devices.
    ii. Switchgear and panelboards.
    jj. Transformers.

2. Construction Waste:

    a. Masonry and CMU.
    b. Lumber.
    c. Wood sheet materials.
    d. Wood trim.
    e. Metals.
    f. Insulation.
    g. Carpet and pad.
    h. Gypsum board.
    i. Piping.
    j. Electrical conduit.
    k. Packaging: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:

        1) Paper.
        2) Cardboard.
        3) Boxes.
        4) Plastic sheet and film.
        5) Polystyrene packaging.
        6) Wood crates.
        7) Plastic pails.

1.5 ACTION SUBMITTALS

A. Waste Management Plan: Submit plan within 10 business days of date established for the Notice to Proceed.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For waste management company.

B. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Include the following information:

1. Material category.
2. Generation point of waste.
3. Total quantity of waste in tons.
4. Quantity of waste salvaged, both estimated and actual in tons.
5. Quantity of waste recycled, both estimated and actual in tons.
6. Total quantity of waste recovered (salvaged plus recycled) in tons.
7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

C. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

D. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

E. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

G. Documentation: Documentation shall be provided to the enforcing agency which demonstrates compliance with CALGreen Sections 5.408.1.1 through 5.408.1.3. The waste management plans shall be updated as necessary and shall be accessible during construction for examination by the enforcing agency.

1.7 QUALITY ASSURANCE

A. Waste Management Company Qualifications: Utilize a waste management company that can provide verifiable documentation that the percentage of construction and demolition waste materials diverted from the landfill complies with CALGreen.

B. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.

C. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

D. Waste Management Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:

1. Review and discuss waste management plan including responsibilities of waste management coordinator.
2. Review requirements for documenting quantities of each type of waste and its disposition.
3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
5. Review waste management requirements for each trade.

1.8 WASTE MANAGEMENT PLAN

A. General: Where a local jurisdiction does not have a construction and demolition waste management ordinance that is more stringent, submit a construction waste management plan that:

1. Identifies the construction and demolition waste materials to be diverted from disposal by efficient usage, recycling, reuse on the project or salvage for future use or sale.
2. Determines if construction and demolition waste materials will be sorted on-site (source-separated) or bulk mixed (single stream).
3. Identifies diversion facilities where construction and demolition waste material collected will be taken.
4. Specifies that the amount of construction waste and demolition materials diverted shall be calculated by weight or volume, but not by both.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

1. Comply with operation, termination, and removal requirements in Section 015000 "Temporary Facilities and Controls."

B. Waste Management Company: Utilize a waste management company that can provide verifiable documentation that the percentage of construction waste material diverted from the landfill complies with CALGreen.

C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.

1. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Reuse in the Work: Salvage items for reuse and handle as follows:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
3. Store items in a secure area until installation.
4. Protect items from damage during transport and storage.
5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

B. Salvaged Items for Owner's Use: Salvage items for Owner's use and handle as follows:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's designated storage area.
5. Protect items from damage during transport and storage.

C. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.

D. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.

E. Plumbing Fixtures: Separate by type and size.

F. Lighting Fixtures: Separate lamps by type and protect from breakage.

G. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall be per Owner/Contractor agreement.

C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.

1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.

    a. Inspect containers and bins for contamination and remove contaminated materials if found.

2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from the weather.
5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor.

3.4 RECYCLING DEMOLITION WASTE

A. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.

1. Pulverize concrete to maximum 1-1/2-inch size.

B. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.

1. Pulverize masonry to maximum 1-1/2-inch size.
2. Clean and stack undamaged, whole masonry units on wood pallets.

C. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.

D. Metals: Separate metals by type.

1. Structural Steel: Stack members according to size, type of member, and length.
2. Remove and dispose of bolts, nuts, washers, and other rough hardware.

E. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.

F. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.

G. Metal Suspension System: Separate metal members including trim, and other metals from acoustical panels and tile and sort with other metals.

H. Carpet and Pad: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.

1. Store clean, dry carpet and pad in a closed container or trailer provided by Carpet Reclamation Agency or carpet recycler.

I. Carpet Tile: Remove debris, trash, and adhesive.

1. Stack tile on pallet and store clean, dry carpet in a closed container or trailer provided by Carpet Reclamation Agency or carpet recycler.

J. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.

K. Conduit: Reduce conduit to straight lengths and store by type and size.

3.5 RECYCLING CONSTRUCTION WASTE

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Polystyrene Packaging: Separate and bag materials.
3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:

1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

a. Comply with requirements in Section 329300 "Plants" for use of clean sawdust as organic mulch.

C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.

1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

a. Comply with requirements in Section 329300 "Plants" for use of clean ground gypsum board as inorganic soil amendment.

3.6 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

C. Disposal: Remove waste materials from Owner's property and legally dispose of them.

3.7 ATTACHMENTS

A. City of GeneThe Waste Management Form.

END OF SECTION 017419

Waste Management Form – Part I
Construction & Demolition (C&D) Debris Deposit Program

Required for projects described in Municipal Code §66.0601-66.0610.

Deposit will be fully refunded if debris generated from the project is recycled at the required rate.* If the minimum required recycling rate is not met, the deposit refund will be prorated. **Refund request must be submitted within 180 days from final inspection** and must be accompanied by weigh tickets for ALL debris generated, including all trash, reuse and recycling.

Complete Part I before obtaining a building, combination or demolition permit.
Submit this form and your deposit to the Development Services Department staff at permit issuance.

Refundable Party Contact Information:

Name _____ Title _____ Company _____

Address _____ City _____ State _____ Zip _____

Phone _____ Email _____

Project Information:

Approval/Permit No. _____ Project Title _____

Project Address _____ Zip _____

Project Type: ☐ *New Construction* ☐ *Addition/Alteration* ☐ *Demolition*

Building Type: ☐ *Commercial* ☐ *Residential*

Estimated Square Feet _____

Estimated Start Date _____/_____/_____

Estimated Completion Date _____/_____/_____

TO BE FILLED OUT BY DSD STAFF
"C&D Deposit" Paid $_____
Invoice # _____ Date Paid _____

Fill out the table with *estimated* quantities in tons for each material that will be generated by your project. **Note: A + B = C**
Please use the ***City Construction and Demolition Debris Conversion Table*** if converting from volume to tonnage.

Material Type	A *Estimated* Salvage, Reuse or Recycle	B *Estimated* Disposal (Trash)	C *Estimated* Total Debris Quantity	Hauler	Certified Recycling Facility or Disposal Destination
Asphalt & Concrete					
Brick / Masonry / Tile					
Cabinets, Doors, Fixtures, Windows (circle all that apply)					
Cardboard					
Carpet, Padding / Foam					
Ceiling Tile (acoustic)					
Dirt					
Drywall					
Landscape Debris					
Mixed C&D Debris					
Mixed Inerts					
Roofing Materials					
Scrap Metal					
Stucco					
Unpainted Wood & Pallets					
Garbage / Trash					
Other:					
TOTAL					

*** Diversion Requirement: 50% for permits issued through June 30, 2016, and 65% for permits issued starting on July 1, 2016.**
To estimate Recycling Rate: (Total A/Total C) x 100 = Recycling %

C&D debr , mercury switches, light bulbs, ballasts or other hazardous wastes that require removal prior to disposal.
The Mir pt hazardous waste. For information on waste acceptance at the Miramar Landfill, call (858) 694-7000.

Waste Management Form – Part II
Construction & Demolition (C&D) Debris Deposit Program

Required for projects described in Municipal Code §66.0601-66.0610.

Complete Part II after final inspection.
Submit with ALL trash, salvage, reuse and recycling weigh tickets.

Send this completed form and all documentation:

By Mail

City of SeneTheo
Environmental Services Department
Attn: C&D Diversion Coordinator
9601 Ridgehaven Court, Suite 320
SeneTheo, CA 92123-1636

By Fax

Attn: C&D Diversion Coordinator
(858) 492-5089

By Email

ESD_CD@sandiego.gov

Applicants must submit refund requests within 180 days from project final inspection. Requests submitted after 180 days will not be eligible for a refund. Refunds will not be issued if all requested information and documentation is not provided. Refunds will be mailed within 45 business days following receipt of all proper forms and documentations. If the minimum required recycling rate is not met, the deposit refund will be prorated.

Project Information

Approval/Permit No. _____ Project No. _____ Project Title _____

Final Inspection Date _____/_____/_____ Project Address _____

Affirmation

Applicant is advised of SeneTheo Municipal Code section 11.0401(b) which states: "No person willfully shall make a false statement or fail to report any material fact in any application for City license, permit, certificate, employment or other City action under the provisions of the SeneTheo Municipal Code."

I certify under penalty of perjury under the laws of the State of California that the information provided in and with this form pertains to construction and demolition debris generated only from the project listed in Part I, that I have reviewed the accuracy of the information, and that the information is true and correct to the best of my knowledge and belief.

Name _____ Title _____ Company _____

Signature _____ Date _____

Payment Information

Check will be made payable to the Refundable Party identified on the Development Services Department's paid invoice on which the "C&D Deposit" was assessed. Please provide complete mailing address below.

If payment is to be made to a different party, the Refundable Party must *sign* in the box below, *designate* to whom the check will be payable, and *provide* complete mailing address.

By signing my name, I _____ (Refundable Party (print name)), _____ (Company), _____ (Signature),

authorize the refund check to be made payable to: _____

Refund Mailing
Address: _____ City _____ State _____ Zip+4_____

Please contact the City of SeneTheo Environmental Services Department: visit www.recyclingworks.com and follow the link to C&D recycling.

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.
5. Repair of the Work.

B. Related Requirements:

1. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
2. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
3. Section 017900 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.3 ACTION SUBMITTALS

A. Product Data: For cleaning agents.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Certificate of Construction Phase Commissioning Completion: From commissioning agent.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.6 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 business days prior to requesting observation for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number where applicable.
5. Submit test/adjust/balance records.
6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 business days prior to requesting observation for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
6. Advise Owner of changeover in heat and other utilities.
7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements, including touchup painting.
10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Observation: Submit a written request for observation to determine Substantial Completion a minimum of 10 business days prior to date the work will be completed and ready for final observation and tests. On receipt of request, Architect will either proceed with observation or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after observation or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Re-observation: Request re-observation when the Work identified in previous observations as incomplete is completed or corrected.
2. Results of completed observation will form the basis of requirements for final completion.

1.7 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final observation for determining final completion, complete the following:

1. Submit a final Application for Payment according to Section 012900 "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion observation list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.

B. Final Observation: Submit a written request for final observation to determine acceptance a minimum of 10 business days prior to date the work will be completed and ready for final observation and tests. On receipt of request, Architect will either proceed with observation or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after observation or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Re-observation: Request re-observation when the Work identified in previous observations as incomplete is completed or corrected.

1.8 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction. Use form mutually agreeable to Owner, Architect, and General Contractor.

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:

a. Project name.
b. Date.
c. Name of Architect.
d. Name of Contractor.
e. Page number.

4. Submit list of incomplete items in the following format:

a. MS Excel electronic file. Architect will return annotated file.
b. PDF electronic file. Architect will return annotated file.

1.9 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

1. Submit on digital media acceptable to Architect and email to Architect.

D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the 2016 California Green Building Standards Code.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting observation for certification of Substantial Completion for entire Project or for a designated portion of Project:

a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
f. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
g. Sweep concrete floors broom clean in unoccupied spaces.
h. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
i. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
j. Remove labels that are not permanent.
k. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
l. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
m. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
n. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.

1) Clean HVAC system in compliance with Division 23 Section “HVAC Air-Distribution System Cleaning” or if section is not provided, in compliance with NADCA ACR. Provide written report on completion of cleaning.

o. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
p. Leave Project clean and ready for occupancy.

C. Construction Waste Disposal: Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations before requesting observation for determination of Substantial Completion.

B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.

    a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.

3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory manuals.
2. Emergency manuals.
3. Systems and equipment operation manuals.
4. Systems and equipment maintenance manuals.
5. Product maintenance manuals.

B. Related Requirements:

1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
2. Section 019113 "General Commissioning Requirements" for verification and compilation of data into operation and maintenance manuals.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Architect and Commissioning Authority will comment on whether content of operation and maintenance submittals is acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operation and maintenance manuals in the following format:

1. Submit in pdf format on digital media acceptable to Owner. Enable reviewer comments on draft submittals.

C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect and Commissioning Authority will comment on whether general scope and content of manual are acceptable.

D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect and Commissioning Authority will return copy with comments.

1. Correct or revise each manual to comply with Architect's and Commissioning Authority's comments. Submit copies of each corrected manual within 15 business days of receipt of Architect's and Commissioning Authority's comments and prior to commencing demonstration and training.

E. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.5 FORMAT OF OPERATION AND MAINTENANCE MANUALS

A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

1.6 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Construction Manager.
7. Name and contact information for Architect.
8. Name and contact information for Commissioning Authority.
9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
10. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.7 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:

1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
2. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

1.8 EMERGENCY MANUALS

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

B. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
3. Gas leak.
4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

E. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

1.9 SYSTEMS AND EQUIPMENT OPERATION MANUALS

A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor has delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

C. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

D. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.10 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.

C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of maintenance manuals.

1.11 PRODUCT MAINTENANCE MANUALS

A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

E. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for the Contractor's preparation of project record documents, including the following:

1. Construction Record Drawings (formerly designated "As-Built Drawings").
2. Construction Record Specifications.
3. Construction Record Product Data.
4. Miscellaneous record submittals.

B. Related Requirements:

1. Section 017300 "Execution" for final property survey.
2. Section 017700 "Closeout Procedures" for general closeout procedures.
3. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

A. Construction Record Drawings: Submit one set of marked-up record prints scanned in PDF electronic file format.

B. Construction Record Specifications: Submit one set of marked-up Project Specifications, including addenda and contract modifications, scanned in PDF electronic file format.

C. Construction Record Product Data: Submit annotated PDF electronic files and directories of each submittal.

D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.

E. Reports: Submit written report indicating items incorporated into project record documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

1.4 CONSTRUCTION RECORD DRAWINGS

A. Record Prints: The Contractor shall maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.

1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
b. Accurately record information in an acceptable drawing technique.
c. Record data as soon as possible after obtaining it.
d. Record and check the markup before enclosing concealed installations.
e. Cross-reference record prints to corresponding archive photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:

a. Dimensional changes to Drawings.
b. Revisions to details shown on Drawings.
c. Depths of foundations.
d. Locations and depths of underground utilities.
e. Revisions to routing of piping and conduits.
f. Revisions to electrical circuitry.
g. Actual equipment locations.
h. Duct size and routing.
i. Locations of concealed internal utilities.
j. Changes made by Change Order or Architect's Supplemental Instructions (ASI).
k. Details not on the original Contract Drawings.
l. Field records for variable and concealed conditions.
m. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
7. Format: Submit construction record drawings as scanned PDF electronic files(s) of marked-up paper copy of drawings.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:

1. Format: Annotated PDF electronic file.
2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
3. Refer instances of uncertainty to Architect for resolution.

1.5 CONSTRUCTION RECORD SPECIFICATIONS

A. Preparation: The Contractor shall mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
5. Note related Change Orders, record Product Data, and record Drawings where applicable.

B. Format: Submit record specifications as annotated PDF electronic file.

1.6 CONSTRUCTION RECORD PRODUCT DATA

A. Preparation: The Contractor shall mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, record Specifications, and record Drawings where applicable.

B. Format: Submit record Product Data as annotated PDF electronic file.

1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

1.7 MISCELLANEOUS RECORD SUBMITTALS

A. The Contractor shall assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as PDF electronic file.

1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

1.8 MAINTENANCE OF RECORD DOCUMENTS

A. Maintenance of Record Documents: Store record documents in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 017839

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Instruction in operation and maintenance of systems, subsystems, and equipment.
2. Demonstration and training video recordings.

1.3 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

B. Qualification Data: For instructor.

C. Attendance Record: For each training module, submit list of participants and length of instruction time.

D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.4 CLOSEOUT SUBMITTALS

A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.

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

a. Name of Project.
b. Name and address of videographer.
c. Name of Architect.
d. Name of Construction Manager.
e. Name of Contractor.
f. Date of video recording.

2. Transcript: Prepared and bound in format matching operation and maintenance manuals. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.

3. Transcript: Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.
4. At completion of training, submit complete training manual(s) for Owner's use prepared in same PDF file format required for operation and maintenance manuals specified in Section 017823 "Operation and Maintenance Data."

1.5 QUALITY ASSURANCE

A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.

B. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:

1. Inspect and discuss locations and other facilities required for instruction.
2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
3. Review required content of instruction.
4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.6 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

1.7 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

a. System, subsystem, and equipment descriptions.
b. Performance and design criteria if Contractor is delegated design responsibility.
c. Operating standards.
d. Regulatory requirements.
e. Equipment function.
f. Operating characteristics.
g. Limiting conditions.
h. Performance curves.

2. Documentation: Review the following items in detail:

    a. Emergency manuals.
    b. Systems and equipment operation manuals.
    c. Systems and equipment maintenance manuals.
    d. Product maintenance manuals.
    e. Project Record Documents.
    f. Identification systems.
    g. Warranties and bonds.
    h. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:

    a. Instructions on meaning of warnings, trouble indications, and error messages.
    b. Instructions on stopping.
    c. Shutdown instructions for each type of emergency.
    d. Operating instructions for conditions outside of normal operating limits.
    e. Sequences for electric or electronic systems.
    f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:

    a. Startup procedures.
    b. Equipment or system break-in procedures.
    c. Routine and normal operating instructions.
    d. Regulation and control procedures.
    e. Control sequences.
    f. Safety procedures.
    g. Instructions on stopping.
    h. Normal shutdown instructions.
    i. Operating procedures for emergencies.
    j. Operating procedures for system, subsystem, or equipment failure.
    k. Seasonal and weekend operating instructions.
    l. Required sequences for electric or electronic systems.
    m. Special operating instructions and procedures.

5. Adjustments: Include the following:

    a. Alignments.
    b. Checking adjustments.
    c. Noise and vibration adjustments.
    d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:

    a. Diagnostic instructions.
    b. Test and inspection procedures.

7. Maintenance: Include the following:

    a. Inspection procedures.
    b. Types of cleaning agents to be used and methods of cleaning.
    c. List of cleaning agents and methods of cleaning detrimental to product.
    d. Procedures for routine cleaning.
    e. Procedures for preventive maintenance.
    f. Procedures for routine maintenance.
    g. Instruction on use of special tools.

8. Repairs: Include the following:

    a. Diagnosis instructions.
    b. Repair instructions.
    c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
    d. Instructions for identifying parts and components.
    e. Review of spare parts needed for operation and maintenance.

1.8 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."

B. Set up instructional equipment at instruction location.

1.9 INSTRUCTION

A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
2. Owner will furnish an instructor to describe Owner's operational philosophy.
3. Owner will furnish Contractor with names and positions of participants.

B. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

1. Schedule training with Owner with at least seven days' advance notice.

C. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

D. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a performance-based test.

E. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

1.10 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full HD mode.

1. Submit video recordings on CD/DVD or thumb drive.
2. File Hierarchy: Organize folder structure and file locations according to Project Manual table of contents. Provide complete screen-based menu.
3. File Names: Utilize file names based on name of equipment generally described in video segment, as identified in Project specifications.
4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the equipment demonstration and training recording that describes the following for each Contractor involved on the Project, arranged according to Project Manual table of contents:

a. Name of Contractor/Installer.
b. Business address.
c. Business phone number.
d. Point of contact.
e. Email address.

B. Narration: Include description of items being viewed.

C. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.

D. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 017900

SECTION 018113 - SUSTAINABLE DESIGN REQUIREMENTS - CALGREEN

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general requirements and procedures for compliance with CALGreen Mandatory Requirements for new construction based on the 2016 “California Green Building Standards Code (CALGreen).”

1. Compliance with CALGreen Mandatory Measures may be used as one criterion to evaluate substitution requests and comparable product requests.

B. Related Requirements:

1. Section 017419 “Construction Waste Management” for additional construction waste management requirements.
2. Section 019113 "General Commissioning Requirements" and other Division 23 and 26 Section(s) for commissioning requirements.
3. Division 23 Section(s) for testing, adjusting, and balancing of mechanical systems and controls.
4. Division 26 Section(s) for testing and adjusting of indoor lighting and controls.
5. Specific requirements for CALGreen are included in greater detail in other Sections.

1.3 DEFINITIONS

A. CALGreen: California Code of Regulations, Title 24, Part 11, “California Green Building Standards Code,” 2016 edition.

B. Refer to CALGreen for definition of terms not given herein.

1.4 PERFORMANCE REQUIREMENTS

A. New Construction: Comply with the 2016 California Green Building Standards Code, including, but not limited to, Chapter 5 “Non-Residential Mandatory Measures,” Section 702.1 “Installer Training,” and Section 703 “Verifications.”

B. Alterations: Comply with the 2016 California Green Building Standards Code, including, but not limited to, Chapter 5 “Non-Residential Mandatory Measures,” Section 702.1 “Installer Training,” and Section 703 “Verifications.”

1.5 ADMINISTRATIVE REQUIREMENTS

A. Respond to questions and requests from Architect and the Enforcing Agency regarding CALGreen credits that are the responsibility of the Contractor, that depend on product selection or product qualities, or that depend on Contractor's procedures until the Enforcing Agency has made its determination on the project's CALGreen certification. Document responses as informational submittals.

1.6 ACTION SUBMITTALS

A. General: Submit additional CALGreen submittals required by other Specification Sections.

B. CALGreen submittals are in addition to other submittals. If submitted item is identical to that submitted to comply with other requirements, submit duplicate copies as a separate submittal to verify compliance with indicated CALGreen requirements.

C. CALGreen Documentation Submittals:

1. CALGreen Section 5.408 Construction Waste Reduction, Disposal, and Recycling: Comply with Section 017419 "Construction Waste Management and Disposal."
2. CALGreen Section 5.410.2 Commissioning: A report of commissioning process activities undertaken through the design and construction phases of the project shall be completed and submitted.
3. CALGreen Section 5.410.4 Testing and Adjusting: After completion of testing, adjusting, and balancing, provide a final report of testing, signed by the individual responsible for performing these services, for the following:

    a. HVAC system and controls.
    b. Indoor lighting and controls.

4. CALGreen Section 5.410.4.5 Operation and maintenance (O&M) manual: Comply with Section 017823 “Operation and Maintenance Data.” Include a copy of all inspection verifications and reports required by the enforcing agency.
5. CALGreen Section 5.504.4.1 Adhesive, Sealants and Caulks: Product data for adhesives, sealants and caulks, indicating VOC content of each product used.
6. CALGreen Section 5.404.4.3 Paints and Coatings: Product data for paints and coatings indicating VOC content of each product used.
7. CALGreen Section 5.504.4.4 Carpet Systems: Product data for carpet systems indicating compliance with referenced standard(s).
8. CALGreen Section 5.504.4.5 Composite Wood Products: Product data for composite wood products indicating compliant formaldehyde levels.
9. CALGreen Section 5.504.4.6 Resilient Floor Systems: Product data for resilient flooring systems indicating VOC content of each product used.
10. CALGreen Section 5.508.1 Outdoor Air Quality: Product data for HVAC system, indicating refrigerant complies with referenced standards.

1.7 INFORMATIONAL SUBMITTALS

A. Action Plans: Provide preliminary submittals within 30 business days of date established for the Notice to Proceed indicating how the following requirements will be met:

1. Waste management plan complying with Section 017419 "Construction Waste Management and Disposal."
2. Material Emissions and Pollutant Control Plan: List of proposed products. Indicate each product that complies with criteria, each product that does not, and anticipated quantities of each that will be used. Include calculations showing that percentage of noncompliant products will not exceed allowable limit.

B. CALGreen Progress Reports: Concurrent with each Application for Payment, submit reports comparing actual construction and purchasing activities with CALGreen action plans for the following:

1. CALGreen Sections 5.408.1.4: Waste reduction progress reports complying with Section 017419 "Construction Waste Management and Disposal."

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Provide products and procedures necessary to comply with requirements in this Section for material selection and for material emissions and pollutant control. Although other Sections may specify some requirements for material selection and for material emissions and pollutant control, the Contractor shall provide additional materials and procedures necessary to comply with requirements.

2.2 LOW-EMITTING MATERIALS

A. CALGreen Section 5.504.4.1 Adhesives, Sealants, and Caulks:

1. Adhesives, adhesive bonding primers adhesive primers, sealants, sealant primers and caulks shall comply with local or regional air pollution control or air quality management district rules where applicable, or SCAQMD Rule 1168VOC limits, as shown in Tables 5.504.4.1 and 5.504.4.2. Such products also shall comply with the Rule 1168 prohibition on the use of certain toxic compounds (chloroform, ethylene dichloride, methylene chloride, perchloroethylene and trichloroethylene), except for aerosol products as specified below.
2. Aerosol adhesives, and smaller unit sizes of adhesives, and sealant or caulking compounds (in units of product, less packaging, which do not weigh more than one pound and do not consist of more than 16 fluid ounces) shall comply with statewide VOC standards and other requirements, including prohibitions on use of certain toxic compounds, of California Code of Regulations, Title 17, commencing with Section 94507.

B. CALGreen Section 5.404.4.3: Paints and Coatings:

1. Architectural paints and coatings shall comply with VOC limits in Table 1 of the ARB Architectural Coatings Suggested Control Measure, as shown in Table 5.504.4.3, unless more stringent local limits apply. The VOC content limit for coatings that do not meet the definitions for the specialty coatings categories listed in Table 5.504.4.3 shall be determined by classifying the coating as a Flat, Nonflat or Nonflat-High Gloss coating, based on its gloss, as defined in Subsections 4.21, 4.36 and 4.37 of the 2007 California Air Resources Board, Suggested Control Measure, and the corresponding Flat, Nonflat or Nonflat-High Gloss VOC limit in Table 5.504.4.3 shall apply.
2. Aerosol paints and coatings. Aerosol paints and coatings shall meet the PWMIR Limits for ROC in Section 94522(a)(3) and other requirements, including prohibitions on use of certain toxic compounds and ozone depleting substances, in Sections 94522(c)(2) and (d)(2) of California Code of Regulations, Title 17, commencing with Section 94520; and in areas under the jurisdiction of the Bay Area Air Quality Management District additionally comply with the percent VOC by weight of product limits of Regulation 8 Rule 49.

C. CALGreen Section 5.504.4.4 Carpet Systems:

1. All carpet installed in the building interior shall meet at least one of the following testing and product requirements:
    a. Carpet and Rug Institute's Green Label Plus Program.
    b. Compliant with the VOC-emission limits and testing requirements specified in the California Department of Public Health Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers, Version 1.1, February 2010 (also known as CDPH Standard Method VI.I or Specification 01350).
    c. NSF/ANSI 140 at the Gold level or higher.
    d. Scientific Certifications Systems Sustainable Choice.
    e. Compliant with the California Collaborative for High Performance Schools (CA-CHPS) Criteria Interpretation for EQ 2.2 dated July 2012 and listed in the CHPS High Performance Product Database.
2. All carpet cushion installed in the building interior shall meet the requirements of the Carpet and Rug Institute's Green Label program.
3. All carpet adhesive shall meet the requirements of Table 5.504.4.1.

D. CALGreen Section 5.504.4.5: Composite Wood Products:

1. Hardwood plywood, particleboard and medium density fiberboard composite wood products used on the interior or exterior of the building shall meet the requirements for formaldehyde as specified in ARB's Air Toxics Control Measure for Composite Wood (17 CCR 93120 et seq.), by or before the dates specified in those sections, as shown in CALGreen Table 5.504.4.5 in Division 5.5.

E. CALGreen Section 5.504.4.6: Resilient Flooring Systems:

1. For 80 percent of floor area receiving resilient flooring, installed resilient flooring shall meet at least one of the following:

   a. Certified under the Resilient Floor Covering Institute (RFCI) FloorScore program.
   b. Compliant with the VOC-emission limits and testing requirements specified in the California Department of Public Health's 2010 Standard Method for the Testing and Evaluation Chambers, Version 1.1, February 2010.
   c. Compliant with the California Collaborative for High Performance Schools (CA-CHPS) Criteria Interpretation for EQ 2.2 dated July 2012 and listed in the CHPS High Performance Product Database.
   d. Compliant with CDPH criteria as certified under the Greenguard Children's & Schools Program.

2. Verification of Compliance: Documentation shall be provided verifying that resilient flooring materials meet the pollutant emission limits.

PART 3 - EXECUTION

3.1 Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor-air intakes.

3.2 TESTING AND ADJUSTING

A. CALGreen Section 5.410.4: Conduct testing and adjusting in compliance with Division 23 Section(s) for mechanical systems and controls and with Division 26 Section(s) for lighting systems and controls. After completion of testing, adjusting, and balancing, provide a final report of testing, signed by the individual responsible for performing these services. Submit reports to Architect/Engineer and to Authorities Having Jurisdiction.

3.3 CONSTRUCTION WASTE MANAGEMENT

A. CALGreen Sections 5.408: Comply with Section 017419 "Construction Waste Management and Disposal."

3.4 CONSTRUCTION INDOOR-AIR-QUALITY MANAGEMENT

A. CALGreen Section 5.504.1 Temporary Ventilation: The permanent HVAC system shall only be used during construction if necessary to condition additions or areas of alteration within the required temperature range for material and equipment installation. If the HVAC system is used during construction, use return air filters with a Minimum Efficiency Reporting Value (MERV) of 8, based on ASHRAE ASHRAE 52-1-1992. Replace all filters immediately prior to occupancy, or, if the building is occupied during alteration, at the conclusion of construction.

B. CALGreen Section 5.504.3 Covering of duct openings of mechanical equipment during construction: At time of rough installation and during storage on the construction site until final startup of the heating, cooling and ventilation equipment, all duct and other related air distribution component openings shall be covered with tape, plastic, sheet metal or other methods acceptable to the enforcing agency to reduce the amount of dust, water and debris which may enter the system.

END OF SECTION 018113

SECTION 024116 - STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Demolition and removal of buildings and site work.
2. Removing below-grade construction.
3. Disconnecting, capping or sealing, and removing site utilities.
4. Salvaging items for reuse by Owner.

B. Related Requirements:

1. Section 011000 "Summary" for use of the premises and phasing requirements.
2. Section 013200 "Construction Progress Documentation" for preconstruction photographs taken before building demolition.
3. Section 017419 "Construction Waste Management and Disposal" for salvaging and recycling of materials from structure demolition.
4. Section 024119 "Selective Demolition" for partial demolition of buildings, structures, and site improvements.
5. Section 311000 "Site Clearing" for site clearing and removal of above- and below-grade site improvements not part of building demolition.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and dispose of them off-site.

B. Salvage: Salvaged items shall be removed by Owner.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.5 PRE-DEMOLITION MEETINGS

A. Pre-Demolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be demolished.
2. Review structural load limitations of existing structures.
3. Review and finalize building demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review and finalize protection requirements.
5. Review procedures for noise control and dust control.
6. Review procedures for protection of adjacent buildings.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For demolition contractor and refrigerant recovery technician.

B. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for dust control and, for noise control. Indicate proposed locations and construction of barriers.

1. Adjacent Buildings: Detail special measures proposed to protect adjacent buildings to remain, including means of egress from those buildings.

C. Schedule of Building Demolition Activities: Indicate the following:

1. Detailed sequence of demolition work, with starting and ending dates for each activity.
2. Temporary interruption of utility services.
3. Shutoff and capping or re-routing of utility services.

D. Pre-Demolition Photographs or Video: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Submit before the Work begins.

E. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.7 QUALITY ASSURANCE

A. Demolition Contractor: A firm with not less than 10 years' successful experience in structure demolition similar to extent of that indicated for this Project.

B. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.

1.8 FIELD CONDITIONS

A. Buildings to be demolished will be vacated and their use discontinued before start of the Work.

B. Buildings adjacent to demolition area will be occupied. Conduct building demolition so operations of occupied buildings will not be disrupted.

1. Provide not less than 72 hours' notice of activities that will affect operations of adjacent occupied buildings.
2. Maintain access to existing walkways, exits, and other facilities used by occupants of adjacent buildings.

a. Do not close or obstruct walkways, exits, or other facilities used by occupants of adjacent buildings without written permission from authorities having jurisdiction.

C. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

E. On-site storage or sale of removed items or materials is not permitted.

1.9 COORDINATION

A. Arrange demolition schedule so as not to interfere with Owner's on-site operations or operations of adjacent occupied buildings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing federal (EPA), state, and local notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ASSE A10.6 and NFPA 241.

2.2 SOIL MATERIALS

A. Satisfactory Soils: Comply with requirements in Section 312000 "Earth Moving."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting demolition operations.

B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during building demolition operations.

3.2 PREPARATION

A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Utilities to be Disconnected: Locate, identify, disconnect, and seal or cap off utilities serving buildings and structures to be demolished.

1. Owner will arrange to shut off utilities when requested by Contractor.
2. Arrange to shut off utilities with utility companies.
3. If removal, relocation, or abandonment of utility services will affect adjacent occupied buildings, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
4. Cut off pipe or conduit at a depth of at least 24 inches below depth of new improvements, but no less than minimum 24 inches below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing according to requirements of authorities having jurisdiction.
5. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.4 PROTECTION

A. Existing Facilities: Protect existing adjacent facilities indicated to remain during demolition operations. Maintain exits from existing buildings.

B. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of demolition.

C. Existing Utilities to Remain: Maintain utility services to remain and protect from damage during demolition operations.

1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.
2. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and authorities having jurisdiction.

a. Provide at least 72 hours' notice to occupants of affected buildings if shutdown of service is required during changeover.

D. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction and as indicated. Comply with requirements in Section 015000 "Temporary Facilities and Controls."

1. Protect adjacent buildings and facilities from damage due to demolition activities.
2. Protect existing site improvements, appurtenances, and landscaping to remain.
3. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
4. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
5. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.
6. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.
7. Erect and maintain dustproof partitions and temporary enclosures to limit dust, noise, and dirt migration to occupied portions of adjacent buildings.

E. Remove temporary barriers and protections where hazards no longer exist. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.

3.5 DEMOLITION, GENERAL

A. General: Demolish indicated buildings and site improvements completely. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire-suppression devices during flame-cutting operations.
2. Maintain fire watch personnel during and after flame-cutting operations.
3. Maintain adequate ventilation when using cutting torches.
4. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

B. Site Access and Temporary Controls: Conduct building demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed trafficways if required by authorities having jurisdiction.
2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

C. Explosives: Use of explosives is not permitted.

3.6 DEMOLITION BY MECHANICAL MEANS

A. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on the next lower level.

B. Remove debris from elevated portions of the building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

1. Remove structural framing members and lower to ground by method suitable to minimize ground impact and dust generation.

C. Below-Grade Construction: Unless otherwise indicated, demolish foundation walls and other below-grade construction in accordance with the following:

1. Within footprint of new construction and extending 5 feet outside footprint indicated for new construction:

a. Remove completely all below-grade construction, including foundation walls, grade beams, footings, and conduits/pipes.

2. Elsewhere:

a. Remove all below-grade construction, including foundation walls, grade beams, and footings to depths indicated, or if not indicated, to a depth of at least 12 inches below new construction, but no less than 12 inches below grade.

D. Existing Utilities: Unless otherwise indicated, demolish and completely remove existing utilities and below-grade utility structures no longer proposed for use.

E. Hydraulic Elevator Systems: Demolish and remove elevator system, including cylinder, plunger, well assembly, steel well casing and liner, oil supply lines, and tanks.

3.7 SITE RESTORATION

A. Below-Grade Areas: Completely fill below-grade areas and voids resulting from building demolition operations with satisfactory soil materials according to backfill requirements in Section 312000 "Earth Moving."

B. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

3.8 REPAIRS

A. Promptly repair damage to adjacent buildings caused by demolition operations.

3.9 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction. and recycle or dispose of them according to Section 017419 "Construction Waste Management and Disposal."

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Do not burn demolished materials.

3.10 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by building demolition operations. Return adjacent areas to condition existing before building demolition operations began.

1. Clean roadways of debris caused by debris transport.

END OF SECTION 024116

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.

B. Related Requirements:

1. Section 011000 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
2. Section 017300 "Execution" for cutting and patching procedures.
3. Section 017419 "Construction Waste Management and Disposal" for salvaging and recycling selective demolition material.
4. Section 013516 "Alteration Project Procedures" for general protection and work procedures for alteration projects.
5. Section 024116 "Structure Demolition" for demolition of existing buildings, structures, and associated site improvements.
6. Section 311000 "Site Clearing" for site clearing and removal of above- and below-grade improvements not part of selective demolition.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be reinstalled.

B. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.

C. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be reinstalled.

D. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be reinstalled.

E. Salvage: Salvaged items shall be removed by Owner.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.5 PRE-DEMOLITION MEETINGS

A. Pre-Demolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For demolition contractor and refrigerant recovery technician.

B. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.

C. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

D. Pre-Demolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Submit before Work begins.

E. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

F. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.7 QUALITY ASSURANCE

A. Demolition Contractor: A firm with not less than 10 years' successful experience in selective demolition similar to extent of that indicated for this Project.

B. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.8 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

E. Storage or sale of removed items or materials on-site is not permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.9 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding. Existing warranties include the following:

B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

1.10 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Engage a professional engineer to perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

D. Survey of Existing Conditions: Record existing conditions by use of measured drawings and preconstruction photographs or video.

1. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 PREPARATION

A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
2. Arrange to shut off utilities with utility companies.
3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.

    a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
    c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    e. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
    f. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.4 PROTECTION

A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.
5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."

B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

C. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
5. Maintain fire watch during and after flame-cutting operations.
6. Maintain adequate ventilation when using cutting torches.
7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
10. Dispose of demolished items and materials promptly. Comply with requirements in Section 017419 "Construction Waste Management and Disposal."

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

C. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. 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.

D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

D. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.

E. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight.

1. Remove existing roof membrane, flashings, copings, and roof accessories.
2. Remove existing roofing system down to substrate.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and recycle or dispose of them according to Section 017419 "Construction Waste Management and Disposal."

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

3.8 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

B. Related Requirements:

1. Section 033300 "Architectural Concrete" for general building applications of specially finished formed concrete.
2. Section 312000 "Earth Moving" for drainage fill under slabs-on-grade.
3. Section 321313 "Concrete Paving" for concrete pavement and walks.
4. Section 321316 "Decorative Concrete Paving" for decorative concrete pavement and walks.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete manufacturer.
d. Concrete Subcontractor.
e. Special concrete finish Subcontractor.

2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, methods for achieving specified floor and slab flatness, concrete repair procedures, and concrete protection.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: For liquid floor treatments, statement of VOC content.

C. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.

D. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

E. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

1. Location of construction joints is subject to approval of the Architect.
2. Coordinate construction joint locations with drain locations.
3. Coordinate construction joint locations with ceramic tile control joint locations.

F. Samples: For waterstops, vapor barrier, and vapor barrier accessories.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Welding certificates.

C. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Fiber reinforcement.
6. Waterstops.
7. Curing compounds.
8. Floor and slab treatments.
9. Bonding agents.
10. Adhesives.
11. Vapor retarders.
12. Semirigid joint filler.
13. Joint-filler strips.
14. Repair materials.

D. Material Test Reports: For the following, from a qualified testing agency:

1. Aggregates: Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

E. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer, detailing fabrication, assembly, and support of formwork.

1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.

F. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

G. Field quality-control reports.

H. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

1.9 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

1.10 SEQUENCING

A. Coordinate layout of cold construction joints with the following:

1. Atrium: No cold construction joints in field of atrium floor.
2. Ceramic Tile Floors: Coordinated layout of cold construction joints with ceramic tile control joints.
3. Elsewhere: Coordinate with finished flooring requirements to minimize visual impact of seams in floor areas exposed to view.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301.
2. ACI 117.

2.2 FORM-FACING MATERIALS

A. Source Limitations: Obtain each type form-facing material from single source from single manufacturer.

B. Form-Facing Panels (For Cast-In-Place Concrete Exposed to View): Steel- and glass-fiber-reinforced plastic, or other approved nonabsorptive panel materials that provide continuous, true, and smooth concrete surfaces matching design reference sample and approved mockups. Furnish in largest practicable sizes to minimize number of joints.

1. Form Liners: Units of face design, texture, arrangement, and configuration to match design reference sample and approved mockups. Furnish with manufacturer's recommended liquid-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent surface treatments of concrete.

C. Smooth-Formed Finished Concrete (For Concrete Not Exposed to View): Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.
2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

a. High-density overlay, Class 1 or better.
b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
c. Structural 1, B-B or better; mill oiled and edge sealed.
d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

3. Overlaid Finnish birch plywood.

D. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

E. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

F. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.

G. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

H. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

I. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

J. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

K. Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.3 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.

B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706, deformed.

C. Deformed-Steel Wire: ASTM A 1064.

D. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064, plain, fabricated from as-drawn steel wire into flat sheets.

E. Deformed-Steel Welded-Wire Reinforcement: ASTM A 1064, flat sheet.

2.4 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.5 CONCRETE MATERIALS

A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C 150, Type I/II.
2. Fly Ash: ASTM C 618, Class F.
3. Blended Hydraulic Cement: ASTM C 595, Type IP, portland-pozzolan cement.

C. Normal-Weight Aggregates: ASTM C 33.

1. Maximum Coarse-Aggregate Size: 1 inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Lightweight Aggregate: ASTM C 330, 1-inch nominal maximum aggregate size.

E. Air-Entraining Admixture: ASTM C 260.

F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494, Type A.
2. Retarding Admixture: ASTM C 494, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.
7. Shrinking Reducing Admixture: ASTM C 494, Type S.

G. Water: ASTM C 94 and potable.

2.6 FIBER REINFORCEMENT

A. Synthetic Micro-Fiber: Micro-fibers engineered and designed for use in concrete, complying with ASTM C 1116, Type III, 1/2 inches long.

1. Basis-of-Design Products: Subject to compliance with requirements, provide the following:

a. Propex Concrete Systems: “Fibermesh 150.”
b. Or Comparable Equal.

2.7 WATERSTOPS

A. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.

2.8 VAPOR RETARDERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

1. Stego Industries, LLC; Stego Wrap, 15 mils.

Or a comparable product by the following:

2. Reef Industries, Inc.; Griffolyn 15 mil Green.

B. Sheet Vapor Barrier Performance Requirements:

1. Permeance: Less than 0.01 perms per ASTM E 1745.
2. Strength: Class A per ASTM E 1745.
3. Thickness: 15 mils minimum.
4. Include manufacturer’s accessories, including, but not limited to, adhesives, pressure-sensitive tape, mastic, termination bars, and double-sided tape.

2.9 DRAINAGE COURSE

A. As recommended in project geotechnical report.

2.10 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

1. Products: Subject to compliance with requirements, available product that shall be incorporated into the Work include, but are not limited to, the following:

a. Meadows, W. R., Inc.; LIQUI-HARD.
b. Dayton Superior Corporation; Day-Chem Sure Hard (J-17).
c. Euclid Chemical Company (The), an RPM company; Euco Diamond Hard.
d. Or Equal.

2. Sealers shall have a VOC content of 100 g/L or less.

2.11 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

2.12 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

B. Bonding Agent: ASTM C 1059, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

C. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

1. Types I and II, nonload bearing and Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.13 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109.

2.14 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as indicated.

C. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a w/c ratio as indicated.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

2.15 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings: Normal-weight concrete.

1. Minimum Compressive Strength: As indicated at 28 days.
2. Maximum W/C Ratio: As indicated.
3. Slump Limit: As indicated.

B. Foundation Walls: Normal-weight concrete.

1. Minimum Compressive Strength: As indicated at 28 days.
2. Maximum W/C Ratio: As indicated.
3. Slump Limit: As indicated.
4. Air Content: As indicated

C. Slabs-on-Grade: Normal-weight concrete.

1. Minimum Compressive Strength: As indicated at 28 days.
2. Maximum W/C Ratio: As indicated.
3. Slump Limit: As indicated.
4. Air Content: As indicated.
5. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

D. Suspended Slabs: Normal-weight concrete.

1. Minimum Compressive Strength: As indicated at 28 days.
2. Maximum W/C Ratio: As indicated.
3. Slump Limit: As indicated.
4. Air Content: As indicated.
5. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.
6. Synthetic Micro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than a rate of 1.5 lb/cu. yd.

E. Concrete Toppings: Normal-weight concrete.

1. Minimum Compressive Strength: As indicated at 28 days.
2. Slump Limit: As indicated.
3. Air Content: As indicated.
4. Air Content: Do not allow air content of trowel-finished toppings to exceed 3 percent.

F. Building Frame Members: Normal-weight concrete.

1. Minimum Compressive Strength: As indicated at 28 days.
2. Maximum W/C Ratio: As indicated.
3. Slump Limit: As indicated. 8 inches for concrete with verified slump of 4 inches before adding high-range water-reducing admixture or plasticizing admixture.
4. Air Content: As indicated.

G. Building Walls: Normal-weight concrete.

1. Minimum Compressive Strength: As indicated at 28 days.
2. Maximum W/C Ratio: As indicated.
3. Slump Limit: As indicated.
4. Air Content: As indicated.

2.16 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.17 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

1. Class A, 1/8 inch for smooth-formed finished surfaces.
2. Class B, 1/4 inch for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete, unless otherwise noted in the structural or architectural drawings.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

M. For Concrete Exposed to View:

1. Place form-facing materials and form liners accurately to provide finished surface texture indicated. Provide solid backing and attach securely to prevent deflection and maintain stability of liners during concreting. Prevent form liners from sagging and stretching in hot weather. Seal joints of form liners and form-liner accessories to prevent mortar leaks. Coat form liner with form-release agent.

3.2 EMBEDDED ITEM INSTALLATION

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

A. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 75 percent of its 28-day design compressive strength.

B. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

C. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material are not acceptable for exposed surfaces. Apply new form-release agent.

D. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 SHORING AND RESHORING INSTALLATION

A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 VAPOR-RETARDER INSTALLATION

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.

1. Lap joints 6 inches and seal with manufacturer's recommended tape.
2. Seal all penetrations per manufacturer’s written instructions.
3. Extend vapor barrier to the perimeter of the slab. Seal vapor barrier to entire perimeter wall of footing/grade beam in accordance with manufacturer’s written instructions.
4. Repair damaged areas with vapor barrier material and seal.

3.6 STEEL REINFORCEMENT INSTALLATION

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded-wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.7 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fifth of concrete thickness as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
3. Coordinate joint locations with drains and other exposed systems placed/formed in concrete.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.8 WATERSTOP INSTALLATION

A. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.9 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

3.10 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view.

C. Rubbed Finish: Apply the following to smooth-formed-finished as-cast concrete where indicated:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix 1 part portland cement to 1-1/2 parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.11 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces indicated to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, or membrane roofing. Surfaces shall be formed true in plane, and without honeycombs, voids, dips, or sharp protrusions. For surfaces to receive fluid-applied waterproofing, and while concrete is still plastic, slightly scarify surface with a fine broom.

C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces indicated, exposed to view, or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
2. Finish and measure surface, so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/4 inch.

D. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated and where ceramic or quarry tile is to be installed by either thickset or thinset method. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

3.12 MISCELLANEOUS CONCRETE ITEM INSTALLATION

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases as indicated.
3. Minimum Compressive Strength: As indicated at 28 days.
4. Install dowel rods to connect concrete base to concrete floor as indicated.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
7. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.13 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

   a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
   b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
   c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies does not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

   a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.14 LIQUID FLOOR TREATMENT APPLICATION

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.

   1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
   2. Do not apply to concrete that is less than 28 days' old.
   3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.15 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

   1. Defer joint filling until concrete has aged at least one month. Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.16 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

   1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar matches surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.17 FIELD QUALITY CONTROL (BY OWNER)

A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

C. Inspections:

1. Steel reinforcement placement.
2. Steel reinforcement welding.
3. Headed bolts and studs.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before removal of shores and forms from beams and slabs.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 150 cu. yd. or fraction thereof of each concrete mixture placed each day.

    a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
4. Unit Weight: ASTM C 56, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
5. Compression Test Specimens: ASTM C 31.

    a. Cast and laboratory cure one set of four standard cylinder specimens (minimum) for each composite sample.

6. Compressive-Strength Tests: ASTM C 39; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.

    a. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

7. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
8. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
10. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Architect.
11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

E. Measure floor and slab flatness and levelness according to ACI 117-10 Section 4.8.6 within 72 hours of finishing.

3.18 PROTECTION OF LIQUID FLOOR TREATMENTS

A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 033000

SECTION 033300 - ARCHITECTURAL CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes cast-in-place architectural concrete, including form facings, reinforcement and accessories, concrete materials, concrete mixture design, placement procedures, and finishes.

1. Requirements in Section 033000 "Cast-in-Place Concrete" apply to architectural concrete.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for concrete not designated as architectural concrete. Section also contains additional requirements for polished concrete finishing.

1.3 DEFINITIONS

A. Cast-in-Place Architectural Concrete: Formed concrete that is exposed to view on surfaces of completed structure or building and that requires special concrete materials, formwork, placement, or finishes to obtain specified architectural appearance.

B. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

C. Design Reference Sample: Sample designated by Architect in the Contract Documents that reflects acceptable surface quality and appearance of cast-in-place architectural concrete.

D. Reveal: Projection of coarse aggregate from matrix or mortar after completion of exposure operations.

E. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Require representatives of each entity directly concerned with cast-in-place architectural concrete to attend, including the following:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete manufacturer.
d. Cast-in-place architectural concrete Subcontractor.

2. Review concrete finishes and finishing, crack control, cold- and hot-weather concreting procedures, curing procedures, construction joints, forms and form-removal limitations, reinforcement accessory installation, concrete repair procedures, and protection of cast-in-place architectural concrete.
3. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Formwork Shop Drawings: Show formwork construction, including form-facing joints, rustications, construction and contraction joints, form joint-sealant details, form tie locations and patterns, inserts and embedments, cutouts, cleanout panels, and other items that visually affect cast-in-place architectural concrete.

D. Placement Schedule: Submit concrete placement schedule before start of placement operations. Include locations of all joints, including construction joints.

E. Samples: For each of the following materials:

1. Form-facing panels.
2. Form ties.
3. Form liners.
4. Exposed aggregates.
5. Coarse- and fine-aggregate gradations.
6. Chamfers and rustications.

F. Samples for Verification: Architectural concrete Samples, cast vertically, approximately 12 by 12 by 2 inches, of finishes, colors, and textures to match Architect's design reference sample. Include Sample sets showing the full range of variations expected in these characteristics.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Repair materials.

C. Material Test Reports: For the following, by a qualified testing agency:

1. Aggregates. Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "NRMCA Quality Control Manual - Section 3, Certification of Ready Mixed Concrete Production Facilities."

B. Installer Qualifications: A firm with not less than 10 years' experience installing architectural concrete similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who also meet the qualifications in Section 033000 "Cast-In-Place Concrete." Experience in only installing conventional concrete work is insufficient experience for architectural concrete work.

C. Field Sample Panels (For Architectural Concrete Cast Horizontally): After approval of verification sample and before casting architectural concrete, produce field sample panels to demonstrate the approved range of selections made under Sample submittals. Produce a minimum of three sets of full-scale panels, approximately 48 by 48 inches minimum, to demonstrate the expected range of finish, color, and texture variations.

1. Locate panels as indicated or, if not indicated, as directed by Architect.
2. Demonstrate methods of curing, aggregate exposure, sealers, and coatings, as applicable.
3. In presence of Architect, damage part of an exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair of tie holes and surface blemishes to match adjacent undamaged surfaces.
4. Maintain field sample panels during construction in an undisturbed condition as a standard for judging the completed Work.
5. Demolish and remove field sample panels when directed.

D. Mockups (For Architectural Concrete Cast Vertically): Before casting architectural concrete, build mockups to verify selections made under Sample submittals and to demonstrate typical joints, surface finish, texture, tolerances, and standard of workmanship. Build mockups to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
2. Build mockups of typical exterior wall of cast-in-place architectural concrete as shown on Drawings.
3. Demonstrate curing, cleaning, and protecting of cast-in-place architectural concrete, finishes, and contraction joints, as applicable.
4. In presence of Architect, damage part of the exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair of tie holes and surface blemishes to match adjacent undamaged surfaces.
5. Obtain Architect's approval of mockups before casting architectural concrete.
6. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents.
4. Do not use chemical accelerators unless otherwise specified and approved in design mixtures.

B. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301.
2. ACI 303.1.

2.2 FORM-FACING MATERIALS

A. General:

1. Comply with Section 033000 "Cast-in-Place Concrete" for formwork and other form-facing material requirements.
2. Provide form-facing materials from the available types listed below, whether indicated on Drawings or not, as required to achieve finish matching Architect's design reference sample, approved samples, and approved mockups.

B. Source Limitations: Obtain each type form-facing material from single source from single manufacturer.

C. Form-Facing Panels: Steel- and glass-fiber-reinforced plastic, or other approved nonabsorptive panel materials that provide continuous, true, and smooth architectural concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.

E. Form Liners: Units of face design, texture, arrangement, and configuration to match design reference sample. Furnish with manufacturer's recommended liquid-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent surface treatments of concrete.

F. Rustication Strips: Metal or rigid plastic, or with sides beveled and back kerfed; nonstaining; in longest practicable lengths.

G. Chamfer Strips: Metal, rigid plastic, elastomeric rubber, or dressed wood, 3/4 by 3/4 inch, minimum; nonstaining; in longest practicable lengths.

H. Form Joint Tape: Compressible foam tape; pressure sensitive; AAMA 800; minimum 1/4 inch thick.

I. Form Joint Sealant: Elastomeric sealant complying with ASTM C 920, Type M or Type S, Grade NS, that adheres to form joint substrates.

J. Sealer: Penetrating, clear, polyurethane wood form sealer formulated to reduce absorption of bleed water and prevent migration of set-retarding chemicals from wood.

K. Form-Release Agent: Commercially formulated, colorless form-release agent that will not bond with, stain, or adversely affect architectural concrete surfaces and will not impair subsequent treatments of those surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

L. Surface Retarder: Chemical liquid set retarder, for application on form-facing materials, capable of temporarily delaying final hardening of newly placed concrete surface to depth of reveal specified.

M. Form Ties: Factory-fabricated, internally disconnecting or removable ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

2.3 STEEL REINFORCEMENT AND ACCESSORIES

A. General: Comply with Section 033000 "Cast-in-Place Concrete" for steel reinforcement and other requirements for reinforcement accessories.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire fabric in place; manufactured according to CRSI's "Manual of Standard Practice."

2.4 CONCRETE MATERIALS

A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C 150, Type I.
2. Fly Ash: ASTM C 618, Class C or F.

C. Normal-Weight Aggregates: ASTM C 33, Class 1N coarse aggregate or better, graded. Provide aggregates from single source with documented service-record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse-Aggregate Size: 3/4 inch.
2. Gradation: Uniformly graded.

D. Normal-Weight Fine Aggregate: ASTM C 33, manufactured or natural sand, from same source for entire Project.

E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that does not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. High-Range Water-Reducing Admixture: ASTM C 494, Type A and F.
2. Accelerating Admixture: ASTM C 494 Type C.
3. Shrinking Reducing Admixture: ASTM C 494, Type S:

F. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.

1. Color: As selected by Architect from manufacturer's full range.

G. Water: Potable, complying with ASTM C 94, except free of wash water from mixer washout operations.

2.5 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

1. For integrally colored concrete, curing compound shall be pigmented type approved by color pigment manufacturer.
2. For concrete indicated to be sealed, curing compound shall be compatible with sealer.

2.6 REPAIR MATERIALS

A. Bonding Agent: ASTM C 1059, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

B. Epoxy Bonding Adhesive: ASTM C 881 two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements.

1. Types I and II, nonload bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.7 CONCRETE MIXTURES

A. Obtain each color, size, type, and variety of concrete mixture from single manufacturer with resources to provide cast-in-place architectural concrete of consistent quality in appearance and physical properties.

B. Prepare design mixtures for each type and strength of cast-in-place architectural concrete proportioned on basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed design mixtures based on laboratory trial mixtures.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.

E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

F. Concrete Mixtures:

1. Compressive Strength (28 Days): As indicated on Structural Drawings for conventional concrete, but no less than 5000 psi.
2. Maximum W/C Ratio: As indicated on Structural Drawings, but no greater than 0.40.
3. Slump Limit: As indicated on Structural Drawings.

2.8 CONCRETE MIXING

A. Ready-Mixed or Site-Mixed Architectural Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and furnish batch ticket information.

1. Clean equipment used to mix and deliver cast-in-place architectural concrete to prevent contamination from other concrete.
2. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

A. General: Comply with Section 033000 "Cast-in-Place Concrete" for formwork, embedded items, and shoring and reshoring.

B. Limit deflection of form-facing panels to not exceed ACI 303.1 requirements.

C. In addition to ACI 303.1 limits on form-facing panel deflection, limit cast-in-place architectural concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

1. Class A, 1/8 inch.

D. Construct forms to result in cast-in-place architectural concrete that complies with ACI 117.

E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-in-place surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood rustications, keyways, reglets, recesses, and the like, for easy removal.

1. Seal form joints and penetrations at form ties with form joint tape or form joint sealant to prevent cement paste leakage.
2. Do not use rust-stained steel form-facing material.

F. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

G. Chamfer exterior corners and edges of cast-in-place architectural concrete.

H. Coat contact surfaces of wood rustications and chamfer strips with sealer before placing reinforcement, anchoring devices, and embedded items.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

M. Coat contact surfaces of forms with surface retarder, according to manufacturer's written instructions, before placing reinforcement.

N. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and attach securely to prevent deflection and maintain stability of liners during concreting. Prevent form liners from sagging and stretching in hot weather. Seal joints of form liners and form-liner accessories to prevent mortar leaks. Coat form liner with form-release agent.

3.2 REINFORCEMENT AND INSERT INSTALLATION

A. General: Comply with Section 033000 "Cast-in-Place Concrete" for fabricating and installing steel reinforcement. Securely fasten steel reinforcement and wire ties against shifting during concrete placement.

B. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

3.3 REMOVING AND REUSING FORMS

A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.

1. Schedule form removal to maintain surface appearance that matches approved field sample panels and/or mockups.
2. Cut off and grind glass-fiber-reinforced plastic form ties flush with surface of concrete.

B. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved 28-day design compressive strength. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

C. Clean and repair surfaces of forms to be reused in the Work. Do not use split, frayed, delaminated, or otherwise damaged form-facing material. Apply new form-release agent.

D. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for cast-in-place architectural concrete surfaces.

3.4 JOINTS

A. Construction Joints: Install construction joints true to line, with faces perpendicular to surface plane of cast-in-place architectural concrete, so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete. Align construction joint within rustications attached to form-facing material.
3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
5. Space vertical joints in walls as indicated or if not indicated, such that joints are equally spaces along length of wall in segments not exceeding 5’-0”. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
6. Use bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

B. Contraction Joints: Form weakened-plane contraction joints true to line, with faces perpendicular to surface plane of cast-in-place architectural concrete, so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

3.5 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, form-release agent, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

D. Deposit concrete continuously between construction joints. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 303.1.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. Do not permit vibrators to contact forms.

3.6 FINISHES, GENERAL

A. Architectural Concrete Finish: Match Architect's design reference sample, identified and described as indicated, to satisfaction of Architect.

B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces.

1. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

C. Maintain uniformity of special finishes over construction joints unless otherwise indicated.

3.7 AS-CAST FORMED FINISHES

A. Finish to match approved mock-up and Architect’s reference sample.

B. Form-Liner Finish: Produce a textured surface free of pockets, streaks, and honeycombs, and of uniform appearance, color, and texture.

3.8 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with ACI 301 for hot-weather protection during curing.

B. Begin curing cast-in-place architectural concrete immediately after removing forms from or applying as-cast formed finishes to concrete. Cure according to ACI 308.1, by one or a combination of the following methods that will not mottle, discolor, or stain concrete:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

a. Water.
b. Continuous water-fog spray.
c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

3.9 FIELD QUALITY CONTROL

A. General: Comply with field quality-control requirements in Section 033000 "Cast-in-Place Concrete."

3.10 REPAIR, PROTECTION, AND CLEANING

A. Repair and cure damaged finished surfaces of cast-in-place architectural concrete when approved by Architect. Match repairs to color, texture, and uniformity of surrounding surfaces and to repairs on approved mockups.

1. Remove and replace cast-in-place architectural concrete that cannot be repaired and cured to Architect's approval.

B. Protect corners, edges, and surfaces of cast-in-place architectural concrete from damage; use guards and barricades.

C. Protect cast-in-place architectural concrete from staining, laitance, and contamination during remainder of construction period.

D. Clean cast-in-place architectural concrete surfaces after finish treatment to remove stains, markings, dust, and debris.

E. Wash and rinse surfaces according to concrete finish applicator's written instructions. Protect other Work from staining or damage due to cleaning operations.

1. Do not use cleaning materials or processes that could change the appearance of cast-in-place architectural concrete finishes.

END OF SECTION 033300

SECTION 035413 - GYPSUM CEMENT UNDERLAYMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Self-leveling, gypsum cement underlayment for application below interior floor coverings at wood floor substrates.

B. Related Requirements:

1. Section 012100 "Allowances" for gypsum cement underlayment allowance.
2. Section 035416 “Hydraulic Cement Underlayment” for underlayment material at concrete substrates.
3. Division 09 Sections for patching and leveling compounds applied with floor coverings if not provided under this Section.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: Product data for coatings and primers, indicating VOC content.

C. Shop Drawings: Include plans indicating substrates, locations, and average depths of underlayment based on survey of substrate conditions.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Letter signed and executed by gypsum cement underlayment manufacturer’s technical representative indicating manufacturer’s acceptance of substrate prior to application of hydraulic cement underlayment.

C. Letter from finished flooring manufacturer(s) indicating intent to warrant finished flooring system with application of gypsum cement underlayment provided under this Section.

D. Field quality control reports.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of gypsum cement underlayment has been used for similar applications with successful results, that meets or exceeds performance requirements indicated, and of documenting this performance by inclusion in test reports. Manufacturer shall have factory-authorized service representatives who are available for consultation, periodic Project-site observations, and on-site assistance.

B. Installer Qualifications: A firm with not less than 5 years' experience installing gypsum cement underlayment similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

C. Product Compatibility: Manufacturers of underlayment and floor-covering systems certify in writing that products are compatible.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ventilation, ambient temperature and humidity, and other conditions affecting underlayment performance.

1. Place gypsum cement underlayments only when ambient temperature and temperature of substrates are between 50 and 80 deg F.

1.8 COORDINATION

A. Coordinate application of underlayment with requirements of floor-covering products and adhesives, specified in Division 09 Sections, to ensure compatibility of products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

B. IIC-Rated Assemblies: For IIC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 492 and classified according to ASTM E 989 by an independent testing agency.

C. Floor Flatness Tolerances: Comply with the following unless Division 09 flooring manufacturers' requirements are more stringent:

1. Finish and measure surface, so gap at any point between concrete surface and an unleveled, freestanding, 10-ft-long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/4 inch for the following flooring applications:

a. Ceramic tile with all edges less than 15 inches.

2. Finish and measure surface, so gap at any point between concrete surface and an unleveled, freestanding, 10-ft-long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch for the following flooring applications:

a. Carpet.
b. Resilient flooring.
c. Ceramic tile with at least one edge 15 inches in length or longer.
d. Resinous flooring systems.
e. Sill conditions.
f. Threshold conditions.
g. Other surface applied flooring.

D. Sustainable Design Requirements: Gypsum cement underlayment, including primers and coatings, shall have a VOC content of 50 g/L or less.

2.2 GYPSUM CEMENT UNDERLAYMENTS

A. Gypsum Cement Underlayment: Self-leveling, gypsum cement product that can be applied in minimum uniform thickness of 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Manufacturers: Subject to compliance with requirements, provide gypsum cement underlayment by one of the following:

a. Ardex Americas.
b. Euclid Chemical Company.
c. MAPEI Corporation.
d. United States Gypsum Company.

2. Cement Binder: Gypsum or blended gypsum cement as defined by ASTM C 219.
3. Compressive Strength: Not less than 4000 psi at 28 days when tested according to ASTM C 109.
4. Underlayment Additive: Resilient-emulsion product of underlayment manufacturer, formulated for use with underlayment when applied to substrate and conditions indicated.

B. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch; or coarse sand as recommended by underlayment manufacturer.

1. Provide aggregate when recommended in writing by underlayment manufacturer for underlayment thickness required.

C. Water: Potable and at a temperature of not more than 70 deg F.

D. Reinforcement: For underlayment applied to wood substrates, provide galvanized metal lath or other corrosion-resistant reinforcement recommended in writing by underlayment manufacturer.

E. Primer: Product of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.

F. Corrosion-Resistant Coating: Recommended in writing by underlayment manufacturer for metal substrates.

G. Surface Sealer: Designed to reduce porosity as recommended by manufacturer for type of floor covering to be applied to underlayment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Measure floor substrate flatness in accordance with ACI 117 using 10-foot straightedge method.

1. Identify areas that are not in compliance with “Performance Requirements” article.

B. Examine substrates, with Installer present, for conditions affecting performance of the Work.

C. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Prepare and clean substrate according to manufacturer's written instructions.

1. Treat nonmoving substrate cracks according to manufacturer's written instructions to prevent cracks from telegraphing (reflecting) through underlayment.
2. Fill substrate voids to prevent underlayment from leaking.

B. Concrete Substrates: Use hydraulic cement underlayment in accordance with Section 035416 “Hydraulic Cement Underlayment.”

C. Wood Substrates: Mechanically fasten loose boards and panels to eliminate substrate movement and squeaks. Sand to remove coatings that might impair underlayment bond and remove sanding dust.

1. Install underlayment reinforcement recommended in writing by manufacturer.

D. Metal Substrates: Mechanically remove, according to manufacturer's written instructions, rust, foreign matter, and other contaminants that might impair underlayment bond. Apply corrosion-resistant coating compatible with underlayment if recommended in writing by underlayment manufacturer.

E. Adhesion Tests: After substrate preparation, test substrate for adhesion with underlayment according to manufacturer's written instructions.

F. Sound Control Mat: Install sound control materials according to manufacturer's written instructions.

1. Do not install mechanical fasteners that penetrate through the sound control materials.

3.3 APPLICATION

A. General: Mix and apply underlayment components according to manufacturer's written instructions.

1. Close areas to traffic during underlayment application and for time period after application recommended in writing by manufacturer.
2. Coordinate application of components to provide optimum adhesion to substrate and between coats.
3. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.

B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.

C. Apply underlayment to produce uniform, level surface.

1. Apply a final layer without aggregate to product surface.
2. Feather edges to match adjacent floor elevations.

D. Cure underlayment according to manufacturer's written instructions. Prevent contamination during application and curing processes.

E. Do not install floor coverings over underlayment until after time period recommended in writing by underlayment manufacturer.

F. Apply surface sealer at rate recommended by manufacturer.

G. Remove and replace underlayment areas that evidence lack of bond with substrate, including areas that emit a "hollow" sound when tapped.

3.4 FIELD QUALITY CONTROL

A. Measure gypsum cement underlayment flatness according to ACI 117 upon conclusion of curing period for underlayments. Repair or replace areas that are not in compliance with “Performance Requirements” article.

3.5 PROTECTION

A. Protect underlayment from concentrated and rolling loads for remainder of construction period.

END OF SECTION 035413

SECTION 035416 - HYDRAULIC CEMENT UNDERLAYMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Hydraulic-cement-based, polymer-modified, self-leveling underlayment for application at the following locations:

a. Where existing cast-in-place concrete does not meet finished floor surface tolerances specified herein and/or in other Section(s).
b. Where existing cast-in-place concrete is not level at sill and threshold conditions.
c. At transition locations between adjacent floor coverings that have different thicknesses.
d. Where indicated.

2. Testing and application of systems for the reduction of moisture vapor transmission and alkalinity control for interior concrete slabs that are not in compliance with hydraulic cement manufacturer's written requirements.

B. Related Requirements:

1. Section 035413 "Gypsum Cement Underlayment" for underlayment material at wood substrates.
2. Division 09 Sections for patching and leveling compounds applied with floor coverings if not provided under this Section.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: Product data for coatings, indicating VOC content.

C. Shop Drawings: Include plans indicating substrates, locations, and average depths of underlayment based on survey of substrate conditions.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Letter signed and executed by hydraulic cement underlayment manufacturer's technical representative indicating manufacturer's acceptance of substrate prior to application of hydraulic cement underlayment.

C. Letter from finished flooring manufacturer(s) indicating intent to warrant finished flooring system with application of hydraulic cement underlayment provided under this Section.

D. Field quality control reports.

E. Sample Warranty: For special warranty.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of hydraulic cement underlayment that has been used for similar applications with successful results, that meets or exceeds performance requirements indicated, and of documenting this performance by inclusion in test reports. Manufacturer shall have factory-authorized service representatives who are available for consultation, periodic Project-site observations, and on-site assistance.

B. Installer Qualifications: A firm with not less than 5 years' experience installing hydraulic cement underlayment similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

C. Product Compatibility: Manufacturers of underlayment and floor-covering systems certify in writing that products are compatible.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ventilation, ambient temperature and humidity, and other conditions affecting underlayment performance.

1. Place hydraulic cement underlayments only when ambient temperature and temperature of substrates are between 50 and 80 deg F.

1.8 COORDINATION

A. Coordinate application of underlayment with requirements of floor-covering products and adhesives, specified in Division 09 Sections, to ensure compatibility of products.

1.9 WARRANTY

A. Special Warranty for Moisture/Alkalinity Control System: Manufacturer's standard or customized form in which manufacturer and installer agree to repair or replace materials that fail to control water vapor transmission or fail to control alkalinity within specified warranty period.

1. This warranty includes, but is not limited to, the following:

a. Moisture control system.
b. Underlayments.
c. Floor covering system
d. Labor.

2. Warranty Period: Ten (10) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Floor Flatness Tolerances: Comply with the following unless Division 09 flooring manufacturers' requirements are more stringent:

1. Finish and measure surface, so gap at any point between concrete surface and an unleveled, freestanding, 10-ft-long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/4 inch for the following flooring applications:

a. Ceramic tile with all edges less than 15 inches.

2. Finish and measure surface, so gap at any point between concrete surface and an unleveled, freestanding, 10-ft-long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch for the following flooring applications:

a. Carpet.
b. Resilient flooring.
c. Ceramic tile with at least one edge 15 inches in length or longer.
d. Resilient athletic flooring.
e. Resinous flooring systems (i.e. epoxy, urethane, etc.).
f. Sill conditions.
g. Threshold conditions.
h. Other surface-applied flooring material.

B. Fire-Resistance Ratings (Where hydraulic cement underlayment is part of a fire-resistant rated assembly): Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

C. Sustainable Design Requirements: Hydraulic cement underlayment shall have a VOC content of 50 or less.

2.2 HYDRAULIC CEMENT UNDERLAYMENTS

A. Hydraulic Cement Underlayment: Polymer-modified, self-leveling, hydraulic cement product that can be applied in minimum uniform thickness of 1/4 inch and that can be feathered at edges to match adjacent floor elevations.

1. Manufacturers: Subject to compliance with requirements, and Division 09 flooring manufacturer's written approval, provide product(s) by one of the following:

a. ARDEX GmbH.
b. Custom Building Products.
c. MAPEI Corporation.
d. Or Equal.

2. Cement Binder: ASTM C 150/C 150M, portland cement, or hydraulic or blended hydraulic cement as defined by ASTM C 219.
3. Compressive Strength: Not less than 4000 psi at 28 days when tested according to ASTM C 109/C 109M.
4. Underlayment Additive: Resilient-emulsion product of underlayment manufacturer, formulated for use with underlayment when applied to substrate and conditions indicated.

B. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch; or coarse sand as recommended by underlayment manufacturer.

1. Provide aggregate when recommended in writing by underlayment manufacturer for underlayment thickness required.

C. Water: Potable and at a temperature of not more than 70 deg F.

D. Primer: Product of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.

1. VOC Content: Provide primer with VOC content of 100 g/L or less.

E. Corrosion-Resistant Coating: Recommended in writing by underlayment manufacturer for metal substrates.

F. Surface Sealer: Designed to reduce porosity as recommended by manufacturer for type of floor covering to be applied to underlayment.

G. Moisture and Alkalinity Control System: As recommended by hydraulic cement underlayment manufacturer for mitigation of concrete slabs with moisture emissions and/or alkalinity measurements that are not within hydraulic cement underlayment manufacturer's written limitations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Measure floor substrate flatness in accordance with ACI 117 using 10-foot straightedge method.

1. Identify areas that are not in compliance with "Performance Requirements" article.

B. Examine substrates, with Installer and manufacturer's representative present, for conditions affecting performance of the Work.

C. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Prepare substrates according to manufacturer's written instructions, and with oversight of hydraulic cement underlayment manufacturer's representative, to ensure adhesion of cement underlayment.

B. Concrete Substrates: Prepare according to hydraulic cement underlayment manufacturer's written instructions.

1. Mechanically remove, according to manufacturer's written instructions, laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants that might impair underlayment bond.

2. Moisture, Alkalinity, and Bond Testing: Determine the suitability of the concrete subfloor for receiving the hydraulic cement underlayment with regard to moisture content and pH level by moisture and alkalinity tests. Conduct moisture testing in accordance with ASTM F 1869 (calcium chloride) and ASTM F 2170 (relative humidity) unless otherwise recommended by the hydraulic cement underlayment manufacturer. Conduct alkalinity testing as recommended by the hydraulic cement underlayment manufacturer. Determine the compatibility of the hydraulic cement underlayment to the concrete floors by a bond test in accordance with the hydraulic cement underlayment manufacturer's recommendations. Submit copy of test reports for moisture and alkalinity content of concrete slab, and bond test, stating date of test, person conducting the test, and the area tested.

a. Apply moisture and alkalinity control system as recommended by hydraulic cement underlayment manufacturer. Proceed with installation only after substrates pass testing.

C. Treat nonmoving substrate cracks according to manufacturer's written instructions to prevent cracks from telegraphing (reflecting) through underlayment.

D. Fill substrate voids to prevent underlayment from leaking.

E. Nonporous Substrates: For ceramic tile, quarry tile, and terrazzo substrates, remove waxes, sealants, and other contaminants that might impair underlayment bond, and prepare surfaces according to manufacturer's written instructions.

F. Adhesion Tests: After substrate preparation, test substrate for adhesion with underlayment according to manufacturer's written instructions.

G. Scrape, sand, sweep and vacuum clean substrates to be covered by hydraulic cement underlayments immediately before installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 APPLICATION

A. General: Grind high spots (of concrete prior to application of any vapor control system) and fill low spots to produce level substrate in accordance with “Performance Requirements” article. Mix and apply underlayment components according to manufacturer's written instructions.

1. Close areas to traffic during underlayment application and for time period after application recommended in writing by manufacturer.
2. Coordinate application of components to provide optimum adhesion to substrate and between coats.
3. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.

B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.

C. Apply underlayment to produce uniform, level surface. Comply with “Performance Requirements” article for hydraulic cement underlayment finish tolerances.

1. Apply a final layer without aggregate to product surface.
2. Feather edges to match adjacent floor elevations.

D. Cure underlayment according to manufacturer's written instructions. Prevent contamination during application and curing processes.

E. Do not install floor coverings over underlayment until after time period recommended in writing by underlayment manufacturer.

F. Remove and replace underlayment areas that evidence lack of bond with substrate, including areas that emit a "hollow" sound when tapped.

3.4 FIELD QUALITY CONTROL

A. Measure hydraulic cement underlayment flatness according to ACI 117 upon conclusion of curing period for underlayments. Repair or replace areas that are not in compliance with “Performance Requirements” article.

3.5 PROTECTION

A. Protect underlayment from concentrated and rolling loads for remainder of construction period.

END OF SECTION 035416

SECTION 042200 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Mortar and grout.
3. Steel reinforcing bars.
4. Miscellaneous masonry accessories.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for installing anchor sections of adjustable masonry anchors for connecting to structural steel frame.
2. Section 078443 "Joint Firestopping" for head-of-wall firestopping at CMU walls.

1.3 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315.
3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Material Certificates: For each type and size of the following:

1. Masonry units.

a. Include data on material properties including material test reports substantiating compliance with requirements.
b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.

2. Integral water repellant used in CMUs.
3. Cementitious materials. Include name of manufacturer, brand name, and type.
4. Mortar admixtures.
5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
6. Grout mixes. Include description of type and proportions of ingredients.
7. Reinforcing bars.
8. Joint reinforcement.
9. Anchors, ties, and metal accessories.

C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109 for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

D. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to TMS 602/ACI 530.1/ASCE 6.

E. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of concrete unit masonry which has been used for similar applications with successful results, that meets or exceeds performance requirements indicated, and of documenting this performance by inclusion in test reports. Manufacturer shall have factory-authorized service representatives who are available for consultation, periodic Project-site observations, and on-site assistance.

B. Installer Qualifications: A firm with not less than 10 years' experience installing concrete unit masonry similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.9 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides of walls, and hold cover securely in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 PERFORMANCE REQUIREMENTS

A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.

1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to TMS 602/ACI 530.1/ASCE 6.
2. Determine net-area compressive strength of masonry by testing masonry prisms according to ASTM C 1314.

B. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.

1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

2.3 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6 except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work or will be within 20 feet vertically and horizontally of a walking surface.

2.4 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
2. Provide square-edged units for outside corners unless otherwise indicated.

B. CMUs: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength as indicated in the structural drawings.
2. Density Classification: Medium weight.
3. Size (Width): Manufactured to dimensions 3/8 inch less-than-nominal dimensions.
4. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.
5. Faces to Receive Plaster: Where units are indicated to receive a direct application of plaster, provide textured-face units made with gap-graded aggregates.

2.5 CONCRETE UNIT MASONRY LINTELS

A. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.6 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C 114.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Masonry Cement: ASTM C 91.

E. Mortar Cement: ASTM C 1329.

F. Aggregate for Mortar: ASTM C 144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.

G. Aggregate for Grout: ASTM C 404.

H. Epoxy Pointing Mortar: ASTM C 395, epoxy-resin-based material formulated for use as pointing mortar for glazed or pre-faced masonry units (and approved for such use by manufacturer of units); in color indicated or, if not otherwise indicated, as selected by Architect from manufacturer's colors.

I. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

J. Water: Potable.

2.7 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615 or ASTM A 996, Grade 60.

B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

2.8 TIES AND ANCHORS

A. General: Anchors shall be placed in CMU walls as indicated.

B. Materials: Anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
1. Steel Plates, Shapes, and Bars: ASTM A 36.

C. Partition Top Anchors as indicated.

2.9 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

2.10 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime, masonry cement or mortar cement mortar unless otherwise indicated.
3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.

1. For masonry below grade or in contact with earth, use Type S.
2. For reinforced masonry, use Type S.
3. For mortar parge coats, use Type S.

D. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C 476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
3. Provide grout with a slump of 10 to 11 inches as measured according to ASTM C 143.

E. Epoxy Pointing Mortar: Mix epoxy pointing mortar to comply with mortar manufacturer's written instructions.

1. Application: Use epoxy pointing mortar for exposed mortar joints with pre-faced CMUs.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.
4. Verify that substrates are free of substances that would impair mortar bond.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Build chases and recesses to accommodate items specified in this and other Sections.

B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.

C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4 inches. Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.

H. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

I. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.
2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors as indicated.
3. Wedge nonload-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078443 "Joint Firestopping."

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:

1. Bed face shells in mortar and make head joints of depth equal to bed joints.
2. Bed webs in mortar in all courses of piers, columns, and pilasters.
3. Bed webs in mortar in grouted masonry, including starting course on footings.
4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.

B. Lay solid CMUs with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Set cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.

1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
2. Wet joint surfaces thoroughly before applying mortar.
3. Rake out mortar joints for pointing with sealant.

D. Rake out mortar joints at pre-faced CMUs to a uniform depth of 1/4 inch and point with epoxy mortar to comply with epoxy-mortar manufacturer's written instructions.

E. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

F. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

G. Cut joints flush where indicated to receive waterproofing unless otherwise indicated.

3.6 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:

1. Provide an open space as indicated between masonry and structural steel or concrete. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.7 CONTROL AND EXPANSION JOINTS

A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry as indicated.

3.8 LINTELS

A. Provide concrete unit masonry lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.

B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.9 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height as indicated.
2. Limit height of vertical grout pours to not more than 12.67 ft.

3.10 FIELD QUALITY CONTROL (BY OWNER)

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5.

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.

D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.

F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

G. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for compressive strength.

H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

I. Prism Test: For each type of construction provided, according to ASTM C 1314 at 28 days.

3.11 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

3.12 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042200

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Structural steel.

a. Surface Preparation and Finishing of Structural Steel Framing:

1) Steel Framing Exposed to View: Interior and exterior steel exposed to public / employee view shall be designated AESS, whether indicated or not on the Drawings. Coordinate with Section 051213 "Architecturally Exposed Structural Steel Framing."

2) Steel Framing Concealed from View with a Fire-Resistance Rating:

a) For structural steel framing required to have a fire-resistance rating, prepare steel in compliance with Section 078100 "Applied Fireproofing" manufacturer's written instructions.

3) Steel Framing Concealed from View without a Fire-Resistance Rating:

a) Exterior structural steel framing outside of the conditioned building envelope shall be galvanized, whether indicated or not on the Drawings. Prepare steel in accordance with galvanizing manufacturer's written instructions and galvanize.

b) Interior structural steel framing shall be shop primed. Prepare steel in accordance with Section 099123 "Interior Painting" manufacturer's written instructions and shop prime.

2. Field-installed shear connectors.
3. Grout.

B. Related Requirements:

1. Section 051213 "Architecturally Exposed Structural Steel Framing" for additional requirements for architecturally exposed structural steel.
2. Section 053100 "Steel Decking" for field installation of shear connectors through deck.
3. Section 055000 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame, miscellaneous steel fabrications, and other steel items not defined as structural steel.
4. Section 055113 "Metal Pan Stairs" for metal pan stairs.
5. Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for surface-preparation and priming requirements.

1.3 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.

C. Heavy Sections: Rolled and built-up sections as follows:

1. Shapes included in ASTM A 6 with flanges thicker than 1-1/2 inches.
2. Welded built-up members with plates thicker than 2 inches.
3. Column base plates thicker than 2 inches.

D. Protected Zone: Structural members or portions of structural members indicated as "Protected Zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.

E. Demand Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the Seismic-Load-Resisting System and which are indicated as "Demand Critical" or "Seismic Critical" on Drawings.

1.4 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
5. Identify members and connections of the Seismic-Load-Resisting System.
6. Indicate locations and dimensions of protected zones.
7. Identify demand critical welds.

C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing, including the following:

1. Power source (constant current or constant voltage).
2. Electrode manufacturer and trade name, for demand critical welds.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For installer and fabricator.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Mill test reports for structural steel, including chemical and physical properties.

E. Product Test Reports: For the following:

1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
2. Direct-tension indicators.
3. Tension-control, high-strength, bolt-nut-washer assemblies.
4. Shear stud connectors.
5. Shop primers.
6. Nonshrink grout.

F. Survey of existing conditions.

G. Source quality-control reports.

H. Field quality-control and special inspection reports.

1.8 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD or is an approved fabricator with the Authority Having Jurisdiction.

B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.

C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint or to SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."

D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel."

1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

E. Comply with applicable provisions of the following specifications and documents:

1. AISC 303.
2. AISC 341 and AISC 341s1.
3. AISC 360.
4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A 992.

B. Channels, Angles**,** Other Shapes: ASTM A 36.

C. Plate and Bar: ASTM A 36 or ASTM A 572, Grade 50, as indicated.

D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B , structural tubing.

E. Steel Pipe: ASTM A 53, Type E or Type S, Grade B.

1. Weight Class: As indicated
2. Finish: Black except where indicated to be galvanized.

F. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers; all with plain finish.

1. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with plain finish.

B. High-Strength Bolts, Nuts, and Washers: ASTM A 490, Type 1, heavy-hex steel structural bolts or tension-control, bolt-nut-washer assemblies with splined ends; ASTM A 563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers with plain finish.

1. Direct-Tension Indicators: ASTM F 959, Type 490, compressible-washer type with plain finish.

C. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex or round head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.

1. Finish: Plain

D. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.

E. Unheaded Anchor Rods: ASTM F 1554, Grade as indicated

1. Configuration: Straight.
2. Nuts: ASTM A 563 heavy-hex carbon steel.
3. Plate Washers: ASTM A 36 carbon steel.
4. Washers: ASTM F 436, Type 1, hardened carbon steel.
5. Finish: Plain

F. Headed Anchor Rods: ASTM F 1554, Grade as indicated, straight.

1. Nuts: ASTM A 563 heavy-hex carbon steel.
2. Plate Washers: ASTM A 36 carbon steel.
3. Washers: ASTM F 436, Type 1, hardened carbon steel.
4. Finish: Plain.

G. Threaded Rods: ASTM A 36 unless otherwise noted**.**

1. Nuts: ASTM A 563 heavy-hex carbon steel.
2. Washers: ASTM F 436, Type 1, hardened carbon steel.
3. Finish: Plain.

H. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1035.

I. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.

J. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1018.

2.3 PRIMER

A. Primer: As specified in Section 099123 "Interior Painting" for interior structural steel framing.

B. Galvanizing Repair Paint: ASTM A 780.

2.4 GROUT

A. Metallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.

B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.5 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.

1. Camber structural-steel members where indicated.
2. Fabricate beams with rolling camber up.
3. Identify high-strength structural steel according to ASTM A 6 and maintain markings until structural steel has been erected.
4. Mark and match-mark materials for field assembly.
5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.

C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 2, "Hand Tool Cleaning."

F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

G. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural-steel frame. Straighten as required to provide uniform, square, and true members in completed wall framing. Build up welded framing, weld exposed joints continuously, and grind smooth.

H. Welded Door Frames: Build up welded door frames attached to structural-steel frame. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk machine screws, uniformly spaced not more than 10 inches o.c. unless otherwise indicated.

I. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.6 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: As indicated..

B. Weld Connections: Comply with AWS D1.1 and AWS D1.8 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.7 SHOP PRIMING

A. Shop prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
2. Surfaces to be field welded.
3. Surfaces of high-strength bolted, slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
5. Galvanized surfaces.
6. Surfaces enclosed in interior construction.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

1. In accordance with "Summary" Article above.

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.8 GALVANIZING

A. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the galvanizing manufacturer’s written instructions.

B. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123.

1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
2. Galvanize lintels and other miscellaneous steel framing attached to structural-steel frame and located in exterior walls.

2.9 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Bolted Connections: Inspect and test shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1 and the following inspection procedures, at testing agency's option:

1. Liquid Penetrant Inspection: ASTM E 165.
2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
3. Ultrasonic Inspection: ASTM E 164.
4. Radiographic Inspection: ASTM E 94.

D. In addition to visual inspection, test and inspect shop-welded shear connectors according to requirements in AWS D1.1 for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests according to requirements in AWS D1.1 on additional shear connectors if weld fracture occurs on shear connectors already tested.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Baseplates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.
3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: As indicated

B. Weld Connections: Comply with AWS D1.1 and AWS D1.8 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," for mill material.

3.5 FIELD QUALITY CONTROL (BY OWNER)

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel frame joint details.
2. Verify weld materials and inspect welds.
3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

C. Bolted Connections: Inspect and test bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: Visually inspect field welds according to AWS D1.1.

1. In addition to visual inspection, test and inspect field welds according to AWS D1.1 and the following inspection procedures, at testing agency's option:

a. Liquid Penetrant Inspection: ASTM E 165.
b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
c. Ultrasonic Inspection: ASTM E 164.
d. Radiographic Inspection: ASTM E 94.

E. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1 for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests according to requirements in AWS D1.1 on additional shear connectors if weld fracture occurs on shear connectors already tested.

3.6 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.

B. Touchup Priming: Cleaning and touchup priming are specified in Section 099123 "Interior Painting."

END OF SECTION 051200

SECTION 051213 - ARCHITECTURALLY EXPOSED STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes architecturally exposed structural-steel (AESS). AESS includes structural steel exposed to public/employee view, whether or not indicated on the Drawings.

1. Requirements in Section 051200 "Structural Steel Framing" also apply to AESS.
2. Surface preparation and finishing of AESS:

a. For AESS required to have a fire-resistance rating:

1) Prepare steel in compliance with Section 078123 "Intumescent Fireproofing" manufacturer's written instructions.

b. For AESS not required to have a fire-resistance rating:

1) Prepare steel in compliance with Section 099113 "Exterior Painting" or Section 099123 "Interior Painting" manufacturer's written instructions and prime.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for additional requirements applicable to AESS.
2. Section 055000 "Metal Fabrications" for miscellaneous steel fabrications and other metal items not defined as structural steel.
3. Section 078123 "Intumescent Fireproofing" for surface preparation requirements for AESS indicated to receive intumescent fireproofing.
4. Section 099113 "Exterior Painting" for surface preparation and priming requirements of exterior AESS indicated to be painted.
5. Section 099123 "Interior Painting" for surface preparation and priming requirements of interior AESS indicated to be painted.

1.3 DEFINITIONS

A. AESS: Structural steel designated as "architecturally exposed structural steel" or "AESS" in the Contract Documents.

1. AESS includes structural steel exposed to public/employee view, whether or not indicated on the Drawings.

B. AESS Category: This specification section does not separately classify AESS by categories. As such, all AESS is defined as Category 1 and shall comply with all of the requirements of this Section.

1.4 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Shop Drawings: Show fabrication of AESS components. Shop Drawings for structural steel may be used for AESS provided items of AESS are specifically identified and requirements below are met for AESS.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain. Indicate grinding, finish, and profile of welds.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections. Indicate orientation of bolt heads.
5. Indicate exposed surfaces and edges and surface preparation being used.
6. Indicate special tolerances and erection requirements.

B. Samples: Submit Samples of AESS to set quality standards for exposed welds.

1. Two steel plates, 3/8 by 8 by 4 inches, with long edges joined by a groove weld and with weld ground smooth.
2. Steel plate, 3/8 by 8 by 8 inches, with one end of a short length of rectangular steel tube, 4 by 6 by 3/8 inches, welded to plate with a continuous fillet weld and with weld ground smooth and blended.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator and installer.

B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

C. Field quality control and special inspection reports.

1.8 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD, or is accredited by the IAS Fabricator Inspection Program for Structural Steel (AC 172).

B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category ACSE.

C. Mockups: Build mockups of AESS to set quality standards for fabrication and installation.

1. Build mockup of typical portion of AESS as shown on Drawings.
2. Coordinate intumescent mastic fireproofing requirements with Section 078123 "Intumescent Fireproofing."
3. Coordinate painting requirements with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Use special care in handling to prevent twisting, warping, nicking, and other damage. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.10 FIELD CONDITIONS

A. Field Measurements: Where AESS is indicated to fit against other construction, verify actual dimensions by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 BOLTS, CONNECTORS, AND ANCHORS

A. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, round-head assemblies, consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.

1. Finish: Plain.

B. Corrosion-Resisting (Weathering Steel), Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 3, round-head assemblies, consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.

2.2 FILLER

A. Filler: Polyester filler intended for use in repairing dents in automobile bodies.

2.3 PRIMER

A. Primer: Comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

2.4 FABRICATION

A. Shop fabricate and assemble AESS to the maximum extent possible. Locate field joints at concealed locations if possible. Detail assemblies to minimize handling and to expedite erection.

B. In addition to special care used to handle and fabricate AESS, comply with the following:

1. Fabricate with exposed surfaces smooth, square, and free of surface blemishes including pitting, rust, scale, and roughness.
2. Grind sheared, punched, and flame-cut edges of AESS to remove burrs and provide smooth surfaces and edges.
3. Fabricate AESS with exposed surfaces free of mill marks, including rolled trade names and stamped or raised identification.
4. Fabricate AESS with exposed surfaces free of seams to maximum extent possible.
5. Remove blemishes by filling or grinding or by welding and grinding, before cleaning, treating, and shop priming.
6. Fabricate with piece marks fully hidden in the completed structure or made with media that permits full removal after erection.
7. Fabricate AESS to the tolerances specified in AISC 303 for steel that is designated AESS.
8. Seal-weld open ends of hollow structural sections with 3/8-inch closure plates for AESS.

C. Curved Members: Fabricate indicated members to curved shape by rolling to final shape in fabrication shop.

1. Distortion of webs, stems, outstanding flanges, and legs of angles shall not be visible from a distance of 20 feet under any lighting conditions.
2. Tolerances for walls of hollow steel sections after rolling shall be approximately 1/2 inch.

D. Coping, Blocking, and Joint Gaps: Maintain uniform gaps of 1/8 inch with a tolerance of 1/32 inch for AESS.

E. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

F. Cleaning Corrosion-Resisting Structural Steel: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.5 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Comply with Section 051200 "Structural Steel Framing."

B. Weld Connections: Comply with AWS D1.1 and AWS D1.8 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work, and comply with the following:

1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding specified tolerances.
2. Use weld sizes, fabrication sequence, and equipment for AESS that limit distortions to allowable tolerances.
3. Provide continuous, sealed welds at angle to gusset-plate connections and similar locations where AESS is exposed to weather.
4. Provide continuous welds of uniform size and profile where AESS is welded.
5. Grind butt and groove welds flush to adjacent surfaces within tolerance of plus 1/16 inch, minus zero inch for AESS.
6. Make butt and groove welds flush to adjacent surfaces within tolerance of plus 1/16 inch, minus zero inch for AESS. Do not grind unless required for clearances or for fitting other components, or unless directed to correct unacceptable work.
7. Remove backing bars or runoff tabs; back-gouge and grind steel smooth for AESS.
8. At locations where welding on the far side of an exposed connection of AESS occurs, grind distortions and marking of the steel to a smooth profile aligned with adjacent material.
9. Make fillet welds for AESS oversize and grind to uniform profile with smooth face and transition.
10. Make fillet welds for AESS of uniform size and profile with exposed face smooth and slightly concave. Do not grind unless directed to correct unacceptable work.

2.6 GALVANIZING

A. General: Prior to the galvanizing operation, the Contractor shall identify to the galvanizer the specific assemblies and surfaces receiving a paint or coating system after galvanizing, to ensure that the galvanizing method used on these assemblies is compatible with subsequent application of the paint or coating system. Specifically, such assemblies shall neither be water-quenched, nor receive a chromate conversion coating, as part of the galvanizing operation. For galvanized surfaces to remain exposed to view, the Contractor shall identify to the galvanizer the specific assemblies and surfaces to ensure that the galvanized surfaces are consistent in appearance, finish, and reflectivity.

B. Galvanized Surface Cleaning and Preparation:

1. Galvanized surfaces receiving a paint or coating system shall be cleaned and prepared for coating in accordance with ASTM D 6386 and the written instructions of the painting or coating system manufacturer.
2. Assemblies conforming to the ASTM D 6386 definition for newly galvanized steel shall receive surface smoothing and surface cleaning in accordance with ASTM D 6386 Section 5, and surface preparation in accordance with ASTM D 6386 Section 5.4.1.
3. Assemblies conforming to the ASTM D 6386 definition for partially weathered galvanized steel shall be checked and prepared in accordance with ASTM D 6386 Section 6, before then receiving surface smoothing and surface cleaning in accordance with ASTM D 6386 Section 5, and surface preparation in accordance with ASTM D 6386 Section 5.4.1.
4. Assemblies conforming to the ASTM D 6386 definition for weathered galvanized steel shall be checked and prepared in accordance with ASTM D 6386 Section 7, before then receiving surface smoothing and surface cleaning in accordance with ASTM D 6386 Section 5, and surface preparation in accordance with ASTM D 6386 Section 5.4.1.

C. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123.

1. Fill vent holes and grind smooth after galvanizing.

2.7 SHOP PRIMING

A. Shop prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
2. Surfaces to be field welded.
3. Surfaces to be high-strength bolted with slip-critical connections.
4. Surfaces to receive intumescent fire-resistive materials.
5. Galvanized surfaces.

B. Surface Preparation for AESS: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to Section 099113 “Exterior Painting” and Section 099123 “Interior Painting” manufacturer’s written instructions.

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

B. Examine AESS for twists, kinks, warping, gouges, and other imperfections before erecting.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep AESS secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

1. If possible, locate welded tabs for attaching temporary bracing and safety cabling where they will be concealed from view in the completed Work.
2. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

A. Set AESS accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

1. Erect AESS to the tolerances specified in AISC 303 for steel that is designated AESS.

B. Do not use thermal cutting during erection.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Per Section 051200 “Structural Steel Framing.”
2. Orient bolt heads in same direction for each connection and to maximum extent possible in same direction for similar connections.

B. Weld Connections: Comply with requirements in "Weld Connections" Paragraph in "Shop Connections" Article.

1. Remove backing bars or runoff tabs; back-gouge and grind steel smooth for AESS.
2. Remove erection bolts in AESS, fill holes, and grind smooth.
3. Fill weld access holes in AESS and grind smooth.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect AESS as specified in Section 051200 "Structural Steel Framing." The testing agency is not responsible for enforcing requirements relating to aesthetic effect.

B. Architect will observe AESS in place to determine acceptability relating to aesthetic effect.

3.6 REPAIRS AND PROTECTION

A. Remove welded tabs that were used for attaching temporary bracing and safety cabling and that are exposed to view in the completed Work. Grind steel smooth.

B. Touchup Painting: Cleaning and touchup painting are specified in Section 099113 “Exterior Painting” and Section 099123 “Interior Painting.”

END OF SECTION 051213

SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Composite deck.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.
2. Section 051200 "Structural Steel Framing" for shop- and field-welded shear connectors.
3. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator and installer.

B. Welding certificates.

C. Product Certificates: For each type of steel deck.

D. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:

1. Power-actuated mechanical fasteners.

E. Evaluation Reports: For steel deck, from ICC-ES.

F. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: An experienced fabricator with a minimum 10-year record of successful in-service performance, capable of fabricating steel decking that meet or exceed performance requirements indicated and of documenting this performance by test reports and evaluation reports from ICC-ES. Fabricator shall also be a member of Steel Deck Institute.

B. Installer Qualifications: Engaged an experienced erector who has completed steel deck erection similar in material, design, and extent to that indicated for this Project, and with a minimum 5-year record of successful in-service performance.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide composite deck by one of the following:

1. ASC.
2. Canam.
3. Nucor.
4. Verco.

B. Source limitations: Obtain steel decking from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.3 COMPOSITE DECK

A. Composite Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:

1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33, G60 zinc coating.
2. Profile Depth: As indicated.
3. Design Uncoated-Steel Thickness: As indicated.
4. Span Condition: As indicated.

2.4 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile indicated.

G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

H. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.

I. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0747 inch thick, with factory-punched hole of 3/8-inch minimum diameter.

J. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.

K. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch-wide flanges and sloped recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field.

L. Galvanizing Repair Paint: SSPC-Paint 20 or MIL-P-21035B, with dry film containing a minimum of 94 percent zinc dust by weight.

M. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 COMPOSITE DECK INSTALLATION

A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:

1. Weld Diameter: As indicated.
2. Weld Spacing: Space and locate welds as indicated.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports as indicated.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 2 inches, with end joints as follows:

1. End Joints: Lapped 2 inches minimum where indicated; otherwise lapped 2 inches minimum or butted at Contractor’s option.

D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.

E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

F. Install piercing hanger tabs at 14 inches apart in both directions, within 9 inches of walls at ends, and not more than 12 inches from walls at sides unless otherwise indicated.

3.4 FIELD QUALITY CONTROL (BY OWNER)

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Field welds will be subject to inspection.

C. Prepare test and inspection reports.

3.5 PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 053100

SECTION 054000 - COLD-FORMED METAL FRAMING (DEFERRED APPROVAL)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Exterior non-load-bearing wall framing, galvanized.
2. Exterior ceiling joist and soffit framing, galvanized.
3. Interior non-load-bearing wall, ceiling joist, soffit, and opening framing, where not provided under Section 092216 "Non-Structural Metal Framing."
4. Framing accessories, including, but not limited to: supplementary framing, bracing, bridging, solid blocking, backing, anchor clips, end clips, foundation clips, kickers, hole-reinforcing plates, backer plates, and custom-formed shapes as indicated or as required to provide suitable framing attachments for substrate materials.

B. Exterior cold-formed metal framing is part of a "Deferred Approval." Coordinate with the requirements of Section 013300 "Submittal Procedures" and with the requirements for deferred approvals indicated on the title sheet of the drawings.

C. Related Requirements:

1. Section 061600 "Sheathing" for gypsum sheathing materials to be applied over cold-formed metal framing.
2. Section 092116 "Gypsum Board Shaft Wall Assemblies" for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies.
3. Section 092216 "Non-Structural Metal Framing" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.

1.3 DEFINITIONS

A. CBC: 2016 California Building Code.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include project-specific shop drawings indicating layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
3. Shop Drawings shall be signed and sealed by the qualified California-licensed professional engineer responsible for their preparation.

C. Deferred-Approval Submittal: For exterior cold-formed steel framing, including analysis data and shop drawings, signed and sealed by the qualified California-licensed professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer, installer, and professional engineer.

B. Welding certificates.

C. Product Test Reports: For each listed product, for tests performed by a qualified testing agency.

1. Steel sheet.
2. Expansion anchors.
3. Power-actuated anchors.
4. Mechanical fasteners.
5. Vertical deflection clips.
6. Horizontal drift deflection clips
7. Miscellaneous structural clips and accessories.

D. Research Reports: For non-standard cold-formed steel framing, post-installed anchors, and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

E. Special inspection reports.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of cold-formed metal framing that has been used for similar applications with successful results, that meets or exceeds performance requirements indicated, and of documenting this performance by inclusion in test reports and evaluation reports.

B. Installer Qualifications: A firm with not less than 10 years' experience installing cold-formed metal framing similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section. Installer shall also be a member of the Western Wall and Ceiling Contractor's Association.

C. Engineering Responsibility: Preparation of Shop Drawings, design calculations, deferred-approval submittal, and other structural data by a qualified professional engineer.

D. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the State of California and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed metal framing that are similar to those indicated for this Project in material, design, and extent.

E. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

F. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Steel Stud Manufacturers Association.

G. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code - Steel."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Deferred Approval: Engage a qualified California-licensed professional engineer to design exterior cold-formed steel framing.

B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As indicated on Structural Drawings.

a. Wind Loads: Per the 2016 CBC, based upon criteria indicated on Structural Drawings.
b. Seismic Loads: Cold-formed metal framing shall withstand the effects of earthquake motions as determined according to the 2016 CBC.
c. Story Drift: Accommodate design displacement of adjacent stories as indicated.

1) Amplified (Inelastic) Story Drift Displacement: As indicated on Structural Drawings.

a) Accommodate seismic movement of cold-formed metal framing to prevent component failure.

2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:

a. Non-Load-Bearing Framing: Horizontal deflection of:

1) 1/360 of the wall height for walls clad with gypsum board or plaster.
2) 1/300 of the wall height for walls clad with fiber cement siding.

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b. Ceiling and Soffit Framing: Vertical deflection of:

1) 1/360 of the span for ceilings and soffits of gypsum board or plaster.

3. Thermal Movements: Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:

a. Upward and downward movement of 1/2 inch live load deflection.

5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

C. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100, AISI S200, and the following:

1. Wall Studs: AISI S211.
2. Headers: AISI S212.
3. Lateral Design: AISI S213.

D. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 COLD-FORMED STEEL FRAMING, GENERAL

A. Steel Sheet: ASTM A 1003, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:

1. Grade: As required by structural performance.
2. Coating: G90 or equivalent.

B. Steel Sheet for Vertical Deflection Clips: ASTM A 653, structural steel, zinc coated, of grade and coating as follows:

1. Grade: As required by structural performance.
2. Coating: G90.

2.3 NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness:

a. Exterior walls: As required by structural design, but not less than 0.054 inch.
b. Interior walls: As indicated on Drawings, but not less than 0.033 inch.

2. Flange Depth:

a. Exterior walls: As required by structural design, and not exceed 6 inches except where indicated.
b. Interior walls: As indicated on Drawings.

3. Flange Width:

a. Exterior walls: As required by structural design, but not less than 1-3/8 inch.
b. Interior walls: As indicated on Drawings, but not less than 1-3/8 inch.

4. Section Properties:

a. Exterior walls: As required by structural design.
b. Interior walls: As indicated on Drawings.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: Matching steel studs, unless otherwise indicated.
2. Flange Width:

a. Exterior Walls: As required by structural design.
b. Interior Walls: As indicated on Drawings.

C. Vertical Deflection Clips: Manufacturer's standard clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:

1. Minimum Base-Metal Thickness: Matching steel studs, unless otherwise indicated on Drawings.
2. Flange Width: 1 inch plus twice the design gap.

E. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

F. Z-Shaped Furring: With nonslotted web, minimum face flange of 1-1/4 inches, wall attachment flange of minimum 7/8 inch, minimum uncoated-metal thickness of 0.054 inch, and depth required to fit insulation thickness indicated.

2.4 CEILING AND SOFFIT FRAMING

A. Steel Ceiling and Soffit Framing: Manufacturer's standard C-shaped steel sections, of web depths indicated, punched with standard holes, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness:

a. Exterior Ceilings and Soffits: As required by Structural design, but not less than 0.033 inch.
b. Interior Ceilings and Soffits: As indicated on Drawings, but not less than 0.033 inch.

2. Flange Width:

a. Exterior Ceilings and Soffits: As required by Structural design, but not less than 1-3/8 inches.
b. Interior Ceilings and Soffits: As indicated on Drawings, but not less than 1-3/8 inches.

3. Section Properties:

a. Exterior Ceilings and Soffits: As required by Structural design.
b. Interior Ceilings and Soffits: As indicated on Drawings.

2.5 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Anchor clips.
4. End clips.
5. Foundation clips.
6. Stud kickers and knee braces.
7. Hole reinforcing plates.
8. Backer plates and pre-notched backing tracks.

2.6 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36, zinc coated by hot-dip process according to ASTM A 123.

B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel hex-headed bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by mechanically deposition according to ASTM B 695, Class 50.

C. Post-Installed Concrete Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency. Special inspection of post-installed concrete anchors shall be in compliance with CBC Table 1705.3 and the evaluation report for the anchor.

D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.

1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

2.7 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: ASTM A 780.

B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and 30-minute working time.

D. Shims: Load bearing, high-density multimonomer plastic, and nonleaching; or of cold-formed steel of same grade and coating as framing members supported by shims.

E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.8 FABRICATION

A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

1. Fabricate framing assemblies using jigs or templates.
2. Cut framing members by sawing or shearing; do not torch cut.
3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.

    a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by no fewer than three exposed screw threads.

4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

C. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

H. Install insulation, specified in Section 072100 "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.4 NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of studs to bottom track unless otherwise indicated. Space studs as follows:

1. Exterior Stud Spacing: As required by structural design, and shall not exceed 16 inches on center.
2. Interior Stud Spacing: As indicated on Drawings.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install single deep-leg deflection tracks and anchor to building structure.
2. Connect vertical deflection clips to studs and anchor to building structure.
3. Connect drift clips to cold-formed metal framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.

1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.

G. Door and Window Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

1. Install single king-post stud with 3 inch flange, or two interconnected studs at each jamb, unless otherwise indicated.
2. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

H. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 ERECTION TOLERANCES

A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.6 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform field tests and inspections and prepare test reports.

1. Compliance of seismic design.
2. Verify weld materials and inspect welds.
3. Verify installation of post-installed concrete anchors.

B. Cold-formed metal framing will be considered defective if it does not pass tests and inspections.

C. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.7 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Steel framing and supports for operable partitions.
2. Steel framing and supports for overhead doors and grilles.
3. Steel framing and supports for countertops.
4. Steel tube reinforcement for low partitions.
5. Steel framing and supports for mechanical and electrical equipment.
6. Steel framing and supports for applications where framing and supports are not specified in other Sections.
7. Elevator machine beams, hoist beams, and divider beams if not provided as part of Section 051200 "Structural Steel Framing."
8. Guards between adjacent elevator pits.
9. Steel shapes for supporting elevator door sills.
10. Metal ladders.
11. Miscellaneous steel trim including loading-dock edge angles.
12. Metal bollards.

B. Products furnished, but not installed, under this Section include the following:

1. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
2. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

C. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
2. Section 042200 "Concrete Unit Masonry" for installing anchor bolts, and other items built into unit masonry.
3. Section 051200 "Structural Steel Framing."

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

A. Product Data: For primer products and grout.

B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide project-specific Shop Drawings for the scope of metal fabrications indicated in the “Summary” Article above.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

C. Research/Evaluation Reports: For post-installed anchors, from ICC-ES.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel."

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Channels, Angles: ASTM A 36.

C. Cold-Formed Hollow Structural Sections (HSS): ASTM A 500, Grade B, structural tubing.

D. Steel Pipe: ASTM A 53, Grade B, in weight class as indicated on Drawings.

E. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.

C. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 325, Type 3; with hex nuts, ASTM A 563, Grade C3; and, where indicated, flat washers.

D. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers.

E. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

F. Post-Installed Concrete Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency. Special inspection of post-installed concrete anchors shall be in compliance with CBC Table 1705.3 and the evaluation report for the anchor.

1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.
2. Material for Exterior Locations and Where Stainless Steel is Indicated: Stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

G. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

2.4 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

E. Concrete: Comply with requirements in Section 033000 "Cast-In-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

1. Fabricate units from slotted channel framing where indicated.
2. Furnish inserts for units installed after concrete is placed.

C. Fabricate supports for operable partitions from continuous steel beams of sizes indicated, or if not indicated, in size recommended by partition manufacturer with attached bearing plates, anchors, and braces as indicated, or if not indicated, in size recommended by partition manufacturer. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.

D. Galvanize exterior miscellaneous framing and supports, and prime interior miscellaneous framing and supports with primer specified in Section 099123 "Interior Painting."

2.7 METAL LADDERS

A. General:

1. Comply with ANSI A14.3 unless otherwise indicated.
2. For elevator pit ladders, comply with ASME A17.1/CSA B44.
3. Space siderails 18 inches apart for roof ladders, 16 inches apart for elevator ladders, unless otherwise indicated.
4. Support each ladder at top and bottom and not more than 48 inches o.c. with welded or bolted brackets, made from same metal as ladder.

B. Steel Ladders:

1. Siderails: Continuous, steel flat bars, with eased edges.
2. Rungs: Minimum 3/4" diameter solid steel rods.
3. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
4. Provide nonslip surfaces on top of each rung by coating with abrasive material metallically bonded to rung by a proprietary process.
5. Galvanize and prime interior and exterior ladders, including brackets and fasteners.
6. Elevator pit ladders shall comply with ASME A17.1.

2.8 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

C. Galvanize and prime miscellaneous steel trim.

2.9 METAL BOLLARDS

A. Fabricate metal bollards from steel shapes as indicated on Drawings, or if not indicated, from minimum Schedule 40 steel pipe.

1. Cap bollards with 1/4-inch-thick steel plate.
2. Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.

B. Fabricate bollards with 3/8-inch-thick steel baseplates for bolting to concrete slab. Drill baseplates at all four corners for 3/4-inch anchor bolts.

1. Where bollards are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.

C. Galvanize and prime bollards with primer specified in Section 099113 “Exterior Painting.”

2.10 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.11 GUARDS BETWEEN ADJACENT ELEVATOR PITS

A. Performance Requirements: Screen enclosure, minimum 6’-0” high from pit floor, with openings sized to reject a 2-inch diameter ball. Where access ladders are located at screen enclosure between adjacent pits, extend enclosure 6’-0” above top rung of ladder and 12 inches each side of side rails of ladder.

B. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

1. McNichols Company.

a. Material: Galvanized steel wire cloth.
b. Width and length: As indicated, or if not indicated, as required to comply with performance requirements.
c. Wire Opening: Nominal one wire per inch.
d. Wire Diameter: 0.120 inch.
e. Construction: Welded.

2. Or Comparable Equal.

C. Fittings and Anchors: Provide fittings and anchors to connect steel wire cloth into perimeter framing members to comply with performance requirements indicated.

2.12 FINISHES, GENERAL

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.13 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153 for steel and iron hardware and with ASTM A 123 for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
2. Fill vent holes and grind smooth after galvanizing.
3. Galvanize metal fabrications as indicated above, where indicated on Drawings, and all metal fabrications outside the building envelope, whether indicated or not.

B. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:

1. Galvanized Items: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
2. Non-Galvanized Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

C. Shop Priming: Shop prime steel items unless they are to be embedded in concrete, masonry, or unless otherwise indicated.

1. Shop prime with primers specified in Section 099113 “Exterior Painting” for exterior metal substrates and Section 099123 "Interior Painting" for interior metal substrates, unless otherwise indicated.
2. Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

a. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for operable partitions, overhead doors, and overhead grilles securely to, and rigidly brace from, building structure.

3.3 INSTALLING METAL BOLLARDS

A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.

B. Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Verify weld materials and inspect welds.
2. Verify installation of post-installed concrete anchors.

B. Special inspector will report results promptly and in writing to Contractor and Architect

C. Remove and replace work where test results indicate that it does not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.5 ADJUSTING AND CLEANING

A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055000

SECTION 055113 - METAL PAN STAIRS (DEFERRED APPROVAL)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes interior metal pan stair systems consisting of the following:

1. Preassembled steel stairs with concrete-filled treads.
2. Steel tube railings attached to metal stairs.
3. Steel tube handrails attached to walls adjacent to metal stairs.
4. Surface preparation and shop priming metal pan stairs and railings.

B. Work under this Section is part of a “Deferred Approval.” Coordinate with the deferred approval requirements in Section 013000 “Submittal Procedures” and with the requirements indicated on the Drawings.

C. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for concrete fill for stair treads and platforms.
2. Section 057100 "Decorative Metal Stairs" for decorative metal stairs.
3. Section 099123 “Interior Painting’ for field painting interior metal pan stairs and railings.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Coordinate locations of hanger rods and struts with other work so that they do not encroach on required stair width and are within the fire-resistance-rated stair enclosure.

1.4 ACTION SUBMITTALS

A. Product Data: For metal pan stairs and paint products.

B. Shop Drawings: Include project-specific plans, elevations, sections, details, and attachments to other work.

1. Shop drawings, including analysis data, shall be signed and sealed by the California-licensed professional engineer responsible for their preparation.

C. Samples for Verification: For each type of railing component and fitting.

D. Deferred Approval Submittal: For metal pan stairs and railing systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified California-licensed professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer, installer, and professional engineer.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

D. Research/Evaluation Reports: For post-installed anchors, from ICC-ES.

E. Special inspection reports.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of metal pan stairs that have been used for similar applications with successful results, that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports and calculations. Manufacturer shall have factory-authorized service representatives who are available for consultation, periodic Project-site observations, and on-site assistance.

B. Installer Qualifications: A firm with not less than 5 years' experience installing metal pan stairs similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

C. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the State of California and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of metal pan stair and railing systems that are similar to those indicated for this Project in material, design, and extent.

D. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code - Steel."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide metal pan stair and railing system by one of the following:

1. Pacific Stair Corporation.
2. Or Comparable Equal.

2.2 PERFORMANCE REQUIREMENTS

A. General: Stairs and railings shall be design, engineered, and fabricated to comply with the 2016 California Building Code (CBC).

B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform Load: 100 lbf/sq. ft..
2. Concentrated Load: 300 lbf applied on an area of 4 sq. in..
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch, whichever is less.

C. Structural Performance of Railings: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ft. applied in any direction.
b. Concentrated load of 200 lbf applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
b. Infill load and other loads need not be assumed to act concurrently.

3. Limit deflection of handrails and top rails of guards to L/360 or 1/4 inch, whichever is less.

D. Seismic Performance of Stairs: Metal stairs shall withstand the effects of earthquake motions determined according to the 2016 CBC.

1. Component Importance Factor: 1.5.

E. Story Drift: Accommodate design displacement of adjacent stories as indicated.

1. Amplified (Inelastic) Story Drift Displacement: As indicated on Structural Drawings.

a. Accommodate seismic movement of metal pan stairs to prevent component failure.

F. Accessibility Requirements: Comply with applicable provisions in the 2010 ADA Standards for Accessible Design and the accessibility requirements of the 2016 CBC, including, but not limited to the following:

1. The top of handrail grasping surface shall be mounted as indicated on the Drawings, and shall be mounted between 34 inches to 38 inches above the nosing of the treads surface.
2. The handgrip portion of handrails for stairs and ramps shall not be less than 1-1/4 inches nor more than 1-1/2 inches in cross-sectional dimension and shall be mounted 1-1/2 inches clear from side walls.
3. All surfaces and welded joints of the grip portion of handrails shall be ground smooth with no sharp corners. Gripping surfaces shall be uninterrupted by newel posts, other construction elements or obstructions. Edges shall have a minimum radius of 1/8 inch.
4. Any wall or other surface adjacent to handrail shall be free of sharp or abrasive elements.
5. Provide minimum 2-inch wide contrasting stripe at the upper approach and lower tread of all interior stairs, and at the upper approach and all treads of all exterior treads per CBC 11B-504.4.1.

G. Slip Resistance: Concrete or precast concrete treads shall be slip resistant equivalent to a medium broom finish, applied perpendicular to the path of travel.

H. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

I. For railings that penetrate a waterproofing or roofing system, provide railing systems that are fully watertight to prevent moisture migration from penetrating the membrane.

2.3 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A 36.

C. Steel Tubing: ASTM A 500 (cold formed) or ASTM A 513.

D. Uncoated, Cold-Rolled Steel Sheet: ASTM A 1008, structural steel, Grade 25, unless another grade is required by design loads; exposed.

E. Uncoated, Hot-Rolled Steel Sheet: ASTM A 1011, structural steel, Grade 30, unless another grade is required by design loads.

2.4 FASTENERS

A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.

B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.

C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.

D. Post-Installed Concrete Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency. Special inspection of post-installed concrete anchors shall be in compliance with CBC Table 1705.3 and the evaluation report for the anchor.

2.5 MISCELLANEOUS MATERIALS

A. Shop Primers for Interior Stairs and Railings: Provide primers that comply with Section 099123 "Interior Painting."

B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

C. Concrete Materials and Properties: Comply with requirements in Section 033000 "Cast-In-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.

D. Nonslip-Aggregate Concrete Finish: Factory-packaged abrasive aggregate made from fused, aluminum-oxide grits or crushed emery; rustproof and nonglazing; unaffected by freezing, moisture, or cleaning materials.

E. Welded Wire Reinforcement: ASTM A 185, 6 by 6 inches, W1.4 by W1.4, unless otherwise indicated.

2.6 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, struts, railings, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding unless otherwise indicated.
2. Use connections that maintain structural value of joined pieces.

B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Form exposed work with accurate angles and surfaces and straight edges.

F. Weld connections to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Weld exposed corners and seams continuously unless otherwise indicated.
5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for the following:

    a. Railings: Type 1 welds: no evidence of a welded joint.
    b. Stairs (Excluding Railings): Type 3 welds: partially dressed weld with spatter removed.

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.

2.7 STEEL-FRAMED STAIRS

A. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," Commercial Class, unless more stringent requirements are indicated.

B. Stair Framing:

1. Fabricate stringers as indicated on Drawings, or if not indicated, of steel plates or channels.

    a. Provide closures for exposed ends of channel stringers.

2. Construct platforms of steel plate or channel headers and miscellaneous framing members as needed to comply with performance requirements indicated.
3. Weld stringers to headers; weld framing members to stringers and headers.
4. Where stairs are enclosed by gypsum board assemblies, provide hanger rods or struts to support landings from floor construction above or below. Locate hanger rods and struts where they do not encroach on required stair width and are within the fire-resistance-rated stair enclosure.
5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.

C. Metal Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements, but not less than 0.067 inch.

1. Steel Sheet for Interior Stairs: Uncoated cold or hot-rolled steel sheet unless otherwise indicated.
2. Directly weld metal pans to stringers; locate welds on top of subtreads where they are concealed by concrete fill. Do not weld risers to stringers.
3. Attach risers and subtreads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.
4. Shape metal pans to include nosing integral with riser.
5. Attach abrasive nosings to risers.
6. At Contractor's option, provide stair assemblies with metal pan subtreads filled with reinforced concrete during fabrication.
   Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.

2.8 STAIR RAILINGS

A. Stair Railings, General:

1. Fabricate newels of steel tubing and provide newel caps.
2. Rails may be bent at corners, rail returns, and wall returns, instead of using prefabricated fittings.
3. Connect posts to stair framing by direct welding unless otherwise indicated.

B. Steel Tube Railings: Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of tube, post spacings, and anchorage, but not less than that needed to withstand indicated loads.

1. Rails and Posts: As indicated on Drawings, or if not indicated, 1-1/4 to 1-1/2 inch diameter top and bottom rails and 1-1/2-inch-square posts.
2. Infill: As indicated on Drawings, or if not indicated, 1/2-inch- round or square pickets spaced less than 4 inches clear.

C. Welded Connections: Fabricate railings with welded connections. Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds: no evidence of a welded joint as shown in NAAMM AMP 521.

D. Form changes in direction of railings by any of the following:

1. As detailed.
2. By flush bends or by inserting prefabricated flush-elbow fittings.
3. By radius bends of radius indicated or by inserting prefabricated elbow fittings of radius indicated.

E. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

F. Close exposed ends of railing members with prefabricated end fittings.

G. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.

H. Connect posts to stair framing by direct welding unless otherwise indicated.

I. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.

1. Provide metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.
2. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.

J. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

2.9 STEEL FINISHES

A. Finish metal stairs after assembly.

B. Preparation for Shop Priming: Prepare surfaces to comply with the following:

1. Interior Stairs and Railings: Prepare in accordance with Section 099123 “Interior Painting” manufacturer’s written instructions.

C. Shop Priming: Shop prime steel items unless they are to be embedded in concrete, masonry, or unless otherwise indicated.

1. Shop prime with primers specified in Section 099123 "Interior Painting" for interior stairs and railings unless otherwise indicated.
2. Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

a. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLING METAL PAN STAIRS

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.

D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.

F. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.

G. Place and finish concrete fill for treads and platforms to comply with Section 033000 "Cast-in-Place Concrete."

1. Install abrasive nosings with anchors fully embedded in concrete. Center nosings on tread width.

3.2 INSTALLING RAILINGS

A. Adjust railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loads. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:

1. Anchor posts to steel by welding to steel supporting members.
2. Anchor handrail ends to concrete and masonry with steel round flanges welded to rail ends and anchored with postinstalled anchors and bolts.

B. Attach handrails to wall with wall brackets. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads. Secure wall brackets to building construction as required to comply with performance requirements and as follows:

1. For concrete and solid masonry anchorage, use post-installed anchors.
2. For steel-framed partitions, use self-tapping screws fastened to steel framing or to concealed steel reinforcements.

3.3 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Verify weld materials and inspect welds.
2. Verify installation of post-installed concrete anchors.

B. Special inspector will report results promptly and in writing to Contractor and Architect.

C. Remove and replace work where test results indicate that it does not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.4 ADJUSTING AND CLEANING

A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section Section 099123 "Interior Painting."

END OF SECTION 055113

SECTION 055813 - COLUMN COVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes snap-together metal column covers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, including finishing materials.

B. Shop Drawings: Show fabrication and installation details for column covers.

C. Samples for Verification: For each type of exposed finish required, prepared on 6-inch-square Samples of metal of same thickness and material indicated for the Work.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer

B. Mill Certificates: Signed by stainless-steel manufacturers certifying that products furnished comply with requirements.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of column cover systems that have been used for similar applications with successful results, that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports and labels.

B. Installer Qualifications: A firm with not less than 10 years' experience installing column cover systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Build mockups of typical column covers.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver column covers wrapped in protective coverings and strapped together in suitable packs or in heavy-duty cartons. Remove protective coverings before they stain or bond to finished surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Products: Subject to compliance with requirements, provide column covers by the following:

1. Exterior Column Covers:

a. Petersen Aluminum, Inc.; "PAC-1000R" column cover.

2. Interior Column Covers:

a. Fry Reglet Corporation; "Series E - Economical Butt Joint."

B. Source Limitations:

1. Provide exterior column covers from single source, from single manufacturer.
2. Provide interior column covers from single source, from single manufacture.

2.2 EXTERIOR SNAP-TOGETHER COLUMN COVERS

A. Form column covers to shapes indicated from metal of type and minimum thickness indicated below. Return vertical edges and bend to form hook that engages continuous mounting clips.

1. Aluminum Sheet: ASTM B 209, with not less than strength and durability properties of Alloy 5005-H32, 0.125 inch thick.

a. Finish: High-performance organic coating.

2. Increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as needed to provide flat surfaces where indicated.
3. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.
4. Form returns at vertical joints to provide 5/8-inch- wide reveal at joints. Provide snap-in metal filler strips at reveals that leave reveals flush.
5. Fabricate column covers without horizontal joints.
6. Fabricate base and ceiling rings to match column covers.
7. Where available as a manufacturer's option, apply manufacturer's recommended sound-deadening insulation or mastic to backs of column covers.

2.3 SNAP-TOGETHER COLUMN COVERS

A. Form column covers to shapes indicated from metal of type and minimum thickness indicated below. Return vertical edges and bend to form hook that engages continuous mounting clips.

1. Stainless-Steel Sheet: ASTM A 240 or ASTM A 666, Type 304, 14 gage thick.

a. Finish: No. 4.

2. Increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as needed to provide flat surfaces where indicated.
3. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.
4. Form returns at vertical joints to provide hairline V-joints.
5. Fabricate column covers without horizontal joints.
6. Fabricate base and ceiling rings to match column covers.
7. Where available as a manufacturer's option, apply manufacturer's recommended sound-deadening insulation or mastic to backs of column covers.

2.4 MISCELLANEOUS MATERIALS

A. Fasteners: Fabricated from same basic metal and alloy as fastened metal unless otherwise indicated. Do not use metals that are incompatible with materials joined.

1. Provide concealed fasteners for interconnecting column covers and for attaching them to other work.

B. Sound-Deadening Materials:

1. Insulation: Unfaced, mineral-fiber blanket insulation complying with ASTM C 665, Type I, and passing ASTM E 136 test.
2. Mastic: Cold-applied asphalt emulsion complying with ASTM D 1187.

C. Backing Materials: Provided or recommended by column cover manufacturer.

2.5 FABRICATION, GENERAL

A. Coordinate dimensions and attachment methods of column covers with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned unless otherwise indicated.

B. Form metal to profiles indicated, in maximum lengths to minimize joints. Produce flat, flush surfaces without cracking or grain separation at bends.

2.6 GENERAL FINISH REQUIREMENTS

A. Complete mechanical finishes of flat sheet metal surfaces before fabrication where possible. After fabrication, finish all joints, bends, abrasions, and other surface blemishes to match sheet finish.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.

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.

2.7 ALUMINUM FINISHES

A. High-Performance Organic Finish: Three-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: Custom color to match Architect's sample.

2.8 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

C. Directional Satin Finish: No. 4.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of column covers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Locate and place column covers plumb and in alignment with adjacent construction. Perform cutting, drilling, and fitting required to install column covers.

1. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.

B. Use concealed anchorages where possible.

C. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers as indicated.

D. Corrosion Protection: Apply bituminous paint or other permanent separation materials on concealed surfaces where metals would otherwise be in direct contact with substrate materials that are incompatible or could result in corrosion or deterioration of either material or finish.

3.3 ADJUSTING AND CLEANING

A. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

3.4 PROTECTION

A. Protect finishes from damage during construction period. Remove temporary protective coverings at time of Substantial Completion.

END OF SECTION 055813

SECTION 057000 - DECORATIVE METAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Decorative metal fabrications as indicated on Drawings.

B. Related Requirements:

1. Section 057300 "Decorative Metal Railings" for decorative metal railings.
2. Section 057500 "Decorative Formed Metal" for decorative metal items made from sheet metal.
3. Section 099113 "Exterior Painting" for surface preparation and priming requirements for exterior decorative metal fabricated from ferrous steel.
4. Section 099123 "Interior Painting" for surface preparation and priming requirements for interior decorative metal fabricated from ferrous steel.

1.3 COORDINATION

A. Coordinate installation of anchorages for decorative metal items. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product, including finishing materials.

B. Shop Drawings: Show fabrication and installation details for decorative metal.

1. Include plans, elevations, component details, and attachment details.
2. Indicate materials and profiles of each decorative metal member, fittings, joinery, finishes, fasteners, anchorages, and accessory items.

C. Samples for Verification: For each type of exposed finish.

1. Sections of linear shapes.
2. Full-size Samples of castings and forgings.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

B. Mill Certificates: Signed by manufacturers of stainless-steel certifying that products furnished comply with requirements.

C. Welding certificates.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm experienced in producing decorative metal similar to that indicated for this Project and with a minimum 10 year record of successful in-service performance, as well as sufficient production capacity to produce required units.

B. Installer Qualifications: Fabricator of products.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.2, "Structural Welding Code - Aluminum."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."
3. AWS D1.6, "Structural Welding Code - Stainless Steel."

D. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Build mockups for the following types of decorative metal:

a. First installation of repetitive decorative metal materials. For each repetitive decorative metal materials, build mockup of first installation of such decorative metal component.

2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store decorative metal in a well-ventilated area, away from uncured concrete and masonry, and protected from weather, moisture, soiling, abrasion, extreme temperatures, and humidity.

B. Deliver and store cast-metal products in wooden crates surrounded by enough packing material to ensure that products are not cracked or otherwise damaged.

1.9 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with decorative metal by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

B. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 METALS, GENERAL

A. Metal Surfaces, General: Use materials with smooth, flat surfaces unless otherwise indicated. Use materials without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

2.3 ALUMINUM

A. Fabricate products from alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties for each aluminum form required not less than that of alloy and temper designated below.

B. Bars and Shapes: ASTM B 221, Alloy 6063-T5/T52.

C. Round Tubing: ASTM B 429, Alloy 6063-T6.

D. Tubing: ASTM B 210, Alloy 6063-T832.

E. Plate and Sheet: ASTM B 209, Alloy 3003-H14, Alloy 5005-H32, or Alloy 6061-T6.

F. Forgings: ASTM B 247, Alloy 6061-T6.

G. Castings: ASTM B 26, Alloy A356.0-T6.

2.4 STAINLESS STEEL

A. General: Use grade type 304 for interior use and type 316 for exterior use.

B. Tubing: ASTM A 554.

C. Pipe: ASTM A 312.

D. Castings: ASTM A 743.

E. Sheet, Strip, Plate, and Flat Bar: ASTM A 666.

F. Bars and Shapes: ASTM A 276.

2.5 STEEL AND IRON

A. Tubing: ASTM A 500 (cold formed).

B. Bars: Hot-rolled, carbon steel complying with ASTM A 29, Grade 1010.

C. Plates, Shapes, and Bars: ASTM A 36.

D. Cast Iron: Either gray iron, ASTM A 48, or malleable iron, ASTM A 47 unless otherwise indicated.

E. Steel Sheet, Cold Rolled: ASTM A 1008, either commercial steel or structural steel, exposed.

2.6 FASTENERS

A. Fastener Materials: Unless otherwise indicated, provide the following:

1. General: Where stainless steel fasteners are indicated below, provide Type 304 for interior use and Type 316 for exterior use.
2. Aluminum Items: Aluminum fasteners.
3. Stainless-Steel Items: Stainless-steel fasteners.
4. Dissimilar Metals: Stainless-steel fasteners.

B. Fasteners for Anchoring to Other Construction: Unless otherwise indicated, select fasteners of type, grade, and class required to produce connections suitable for anchoring indicated items to other types of construction indicated.

C. Provide concealed fasteners for interconnecting components and for attaching decorative metal items to other work unless otherwise indicated or unless exposed fasteners are unavoidable.

1. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Post-Installed Concrete Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, with strength capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load as determined by testing per ASTM E 488 conducted by a qualified testing agency.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5 unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy stainless-steel bolts, ASTM F 738, and nuts, ASTM F 836.

2.7 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

1. For aluminum, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

B. Shop Primers for Steel and Iron: Provide primers that comply with Section 099113 "Exterior Painting" for exterior decorative steel, and Section 099123 "Interior Painting" for interior decorative steel.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.8 FABRICATION, GENERAL

A. Assemble items in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

B. Form decorative metal to required shapes and sizes, true to line and level with true curves and accurate angles and surfaces. Finish exposed surfaces to smooth, sharp, well-defined lines and arris.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.

D. Form simple and compound curves in bars, pipe, tubing, and extruded shapes by bending members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces.

E. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1 mm unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

F. Mill joints to a tight, hairline fit. Cope or miter corner joints. Fabricate connections that will be exposed to weather in a manner to exclude water.

G. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.

H. Provide necessary rebates, lugs, and brackets to assemble units and to attach to other work. Cut, reinforce, drill, and tap as needed to receive finish hardware, screws, and similar items unless otherwise indicated.

I. Provide castings that are sound and free of warp, cracks, blowholes, or other defects that impair strength or appearance. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks.

J. Comply with AWS for recommended practices in shop welding. Weld behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded joints of flux, and dress exposed and contact surfaces.

1. Where welding cannot be concealed behind finished surfaces, finish joints to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 Welds: no evidence of a welded joint.

2.9 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.

2.10 ALUMINUM FINISHES

A. High-Performance Organic Finish: Three-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: Custom color to match Architect's sample.

2.11 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.

C. Directional Satin Finish: No. 4.

D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.12 STEEL FINISHES

A. Finish decorative metal after assembly.

B. Preparation for Shop Priming: Prepare surfaces in accordance with Section 099113 "Exterior Painting" for exterior decorative metal, and in accordance with Section 099123 “Interior Painting” for interior decorative metal, and not less than the following:

a. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

C. Shop Priming: Shop prime steel items unless they are to be embedded in concrete, masonry, or unless otherwise indicated.

1. Shop prime with primers specified in Section 099113 “Exterior Painting” for exterior steel substrates and Section 099123 "Interior Painting" for interior steel substrates, unless otherwise indicated.
2. Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

a. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of decorative metal.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Provide anchorage devices and fasteners where needed to secure decorative metal to in-place construction.

B. Perform cutting, drilling, and fitting required to install decorative metal. Set products accurately in location, alignment, and elevation, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items to be built into concrete, masonry, or similar construction.

C. Fit exposed connections accurately together to form tight, hairline joints or, where indicated, uniform reveals and spaces for sealants and joint fillers. Where cutting, welding, and grinding are required for proper shop fitting and jointing of decorative metal, restore finishes to eliminate evidence of such corrective work.

D. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.

E. Install concealed gaskets, joint fillers, insulation, and flashings as work progresses.

F. Restore protective coverings that have been damaged during shipment or installation. Remove protective coverings only when there is no possibility of damage from other work yet to be performed at same location.

1. Retain protective coverings intact; remove coverings simultaneously from similarly finished items to preclude nonuniform oxidation and discoloration.

G. Field Welding: Comply with applicable AWS specification for procedures of manual shielded metal arc welding and requirements for welding and for finishing welded connections in "Fabrication, General" Article. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.

1. Field finish weld areas to match finish of metal surfaces being joined.

H. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.3 CLEANING

A. Unless otherwise indicated, clean metals by washing thoroughly with clean water and soap, rinsing with clean water, and drying with soft cloths.

B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

C. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

D. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

3.4 PROTECTION

A. Protect finishes of decorative metal from damage during construction period with temporary protective coverings approved by decorative metal fabricator. Remove protective covering at time of Substantial Completion.

END OF SECTION 057000

SECTION 057100 - DECORATIVE METAL STAIRS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes custom-fabricated steel-framed decorative metal stairs.

B. Related Requirements:

1. Section 055113 "Metal Pan Stairs" for metal stairs not designated as decorative.
2. Section 057300 "Decorative Metal Railings" for decorative metal railings.
3. Section 099123 "Interior Painting" for field painting decorative metal stairs.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

A. Product Data: For metal stairs and the following:

1. Paint products.
2. Grout.

B. Shop Drawings: Include project-specific shop drawings, including plans, elevations, sections, details, and attachments to other work.

C. Samples for Verification: For each type of exposed finish required.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

D. Research/Evaluation Reports: For post-installed anchors, from ICC-ES.

E. Special inspection reports.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm with not less than 10 years' experience regularly engaged in the fabrication of custom-fabricated decorative metal stairs that have been used for similar applications with successful results, and that meet or exceed performance requirements indicated.

B. Installer Qualifications: Fabricator of products.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code - Steel."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."

D. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Building mockups for each form and finish of decorative metal stair consisting of stringer, tread, and riser assembly that are full size and not less than 24 inches in length.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Use special care in handling to prevent twisting, warping, nicking, and other damage. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with decorative metal stairs by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 METAL STAIRS, GENERAL

A. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," Architectural class, unless more stringent requirements are indicated.

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A 36.

C. Steel Tubing: ASTM A 500 (cold formed) or ASTM A 513.

D. Uncoated, Cold-Rolled Steel Sheet: ASTM A 1008, structural steel, Grade 25, unless another grade is required by design loads; exposed.

2.3 FASTENERS

A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941. Select fasteners for type, grade, and class required.

B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.

C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.

D. Post-Installed Concrete Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency. Special inspection of post-installed concrete anchors shall be in compliance with CBC Table 1705.3 and the evaluation report for the anchor

1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.

2.4 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 099123 "Interior Painting."

B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.5 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, struts, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding unless otherwise indicated.
2. Use connections that maintain structural value of joined pieces.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld connections to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Weld exposed corners and seams continuously unless otherwise indicated.
5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds: no evidence of a welded joint.
6. Remove backing bars or runoff tabs; back-gouge and grind steel smooth.
7. Remove erection bolts, fill holes, and grind smooth.
8. Fill weld access holes and grind smooth.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.

2.6 STEEL-FRAMED STAIRS

A. Stair Framing:

1. Fabricate stringers of steel shapes as indicated on Drawings.

a. Provide closures for open ends of structural steel stringer shapes.

2. Weld stringers to headers; weld framing members to stringers and headers.

B. Subtreads, Risers, and Subplatforms:

1. Fabricate subtreads and subplatforms of steel shapes indicated on Drawings.
2. Weld substreads to stringers. Locate welds on top of subtreads where they will be concealed by finished treads.
3. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.

a. Smooth Soffit Construction: Construct subplatforms with flat metal under surfaces to produce smooth soffits.

2.7 STAIR RAILINGS

A. Comply with applicable requirements in Section 057300 "Decorative Metal Railings."

1. Connect posts to stair framing by direct welding unless otherwise indicated.

2.8 FINISHES

A. Finish metal stairs after assembly.

B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with Section 099123 “Interior Painting” manufacturer’s written requirements, but no less than the following:

1. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

C. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.

D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.

E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

F. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.

3.2 INSTALLING METAL STAIRS

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of baseplates.

B. Set steel stair baseplates on wedges, shims, or leveling nuts. After stairs have been positioned and aligned, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.

1. Use nonmetallic, nonshrink grout unless otherwise indicated.
2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.3 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Verify weld materials and inspect welds.
2. Verify installation of post-installed concrete anchors

B. Special inspector will report results promptly and in writing to Contractor and Architect

C. Architect will observe decorative metal stairs in place to determine acceptability relating to aesthetic effect.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.4 PROTECTION

A. Protect finishes of decorative metal stairs from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work.

3.5 ADJUSTING AND CLEANING

A. Touchup Painting: Cleaning and touchup painting of field welds, connections, and abraded areas of shop paint are specified in Section 099123 "Interior Painting."

END OF SECTION 057100

SECTION 057300 - DECORATIVE METAL RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes stainless-steel decorative railings with stainless-steel wire-rope guard infill.

B. Related Requirements:

1. Section 055113 "Metal Pan Stairs" for steel tube railings for back-of-house stairs and railings.
2. Section 057100 "Decorative Metal Stairs" for decorative metal stairs to receive decorative metal railings provided under this Section.
3. Section 092216 "Non-Structural Metal Framing" for concealed metal backing for anchoring railings.

1.3 DEFINITIONS

A. Railings: Guards, handrails, and similar devices used for protection of occupants at open-sided floor areas and for pedestrian guidance and support, visual separation, or wall protection.

1.4 COORDINATION AND SCHEDULING

A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver items to Project site in time for installation.

B. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not meet structural performance requirements.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data: For grout and anchoring cement.

B. Shop Drawings: Provide project-specific shop drawings, including plans, elevations, sections, and attachment details.

C. Samples for Verification: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
2. Fittings and brackets.
3. Welded connections.
4. Assembled Samples of railing systems, made from full-size components, including top rail, post, handrail, and infill. Show method of finishing members at intersections. Samples need not be full height.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

B. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.

C. Welding certificates.

D. Evaluation Reports: For post-installed anchors, from ICC-ES.

1.8 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm with not less than 10 years' experience regularly engaged in the fabrication of custom-fabricated decorative metal railings that have been used for similar applications with successful results, and that meet or exceed performance requirements indicated.

B. Installer Qualifications: Fabricator of products.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.6, "Structural Welding Code - Stainless Steel."

1.9 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 FABRICATOR

A. Source Limitations: Obtain railings from single source from single fabricator.

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ft. applied in any direction.
b. Concentrated load of 200 lbf applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
b. Infill load and other loads need not be assumed to act concurrently.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior railings by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

C. Product Options: Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods, including structural analysis, preconstruction testing, field testing, and in-service performance.

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

2.3 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.

1. Provide cast-metal brackets with flange tapped for concealed anchorage to threaded hanger bolt.
2. Provide either formed- or cast-metal brackets with predrilled hole for exposed bolt anchorage.
3. Provide formed-steel brackets with predrilled hole for bolted anchorage and with snap-on cover that matches rail finish and conceals bracket base and bolt head.

2.4 STAINLESS STEEL

A. General: Provide Type 304 stainless steel for interior use, and Type 316 for exterior use.

B. Tubing: ASTM A 554.

C. Pipe: ASTM A 312.

D. Sheet, Strip, Plate, and Flat Bar: ASTM A 666.

E. Bars and Shapes: ASTM A 276.

F. Wire Rope and Fittings:

1. Wire Rope: Stainless steel wire rope made from wire complying with ASTM A 492, Type 316 for exterior use, Type 304 for interior use, of size to comply with performance requirements.
2. Wire-Rope Fittings: Connectors of types indicated, fabricated from stainless steel, and with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.

2.5 FASTENERS

A. Fastener Materials: Unless otherwise indicated, provide the following:

1. Stainless-Steel Components: Stainless-steel fasteners, Type 304 for interior use, Type 316 for exterior use.

B. Fasteners for Anchoring to Other Construction: Select stainless steel fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated.

C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless otherwise indicated.

2.6 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.7 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage.

B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Make up wire-rope assemblies in the shop to field-measured dimensions with fittings machine swaged. Minimize amount of turnbuckle take-up used for dimensional adjustment so maximum amount is available for tensioning wire ropes. Tag wire-rope assemblies and fittings to identify installation locations and orientations for coordinated installation.

D. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

E. Form work true to line and level with accurate angles and surfaces.

F. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.

G. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

H. Connections: Fabricate railings with welded connections unless otherwise indicated.

I. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds; no evidence of a welded joint.

J. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.

K. Form changes in direction as follows:

1. As detailed, or if not detailed, by bending to smallest radius that will not result in distortion of railing member.

L. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

M. Close exposed ends of hollow railing members with prefabricated end fittings.

N. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns, unless clearance between end of rail and wall is 1/4 inch or less.

O. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and to prevent bracket or fitting rotation and crushing of substrate.

P. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

Q. Toe Boards: Where indicated and/or required per Code, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.8 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.9 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.

C. Directional Satin Finish: No. 4.

D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.

B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches of post.

3.4 ANCHORING POSTS

A. Anchor posts to substrate below as indicated on Drawings.

B. At exposed welds, fill and grind smooth to create a weld uniform in appearance.

3.5 ATTACHING RAILINGS

A. Anchor railing ends to concrete and masonry with brackets on underside of rails connected to railing ends and anchored to wall construction with anchors and bolts.

B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and connected to railing ends using nonwelded connections.

C. Attach handrails to walls with wall brackets. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

1. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

D. Secure wall brackets and railing end flanges to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For steel-framed partitions, fasten brackets directly to steel framing or concealed steel reinforcements using self-tapping screws of size and type required to support structural loads.

E. Install stainless steel wire rope guards at locations and spacings indicated. Secure wire ropes to posts and tighten to remove slack.

3.6 FIELD QUALITY CONTROL (BY OWNER)

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and to prepare test reports.

1. Verify weld materials and inspect welds.
2. Verify installation of post-installed concrete anchors.

B. Remove and replace railings where test results indicate that they do not comply with specified requirements unless they can be repaired in a manner satisfactory to Architect and comply with specified requirements.

C. Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.

3.7 CLEANING

A. Clean stainless steel by washing thoroughly with clean water and soap, rinsing with clean water, and wiping dry.

3.8 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 057300

SECTION 057500 - DECORATIVE FORMED METAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Decorative formed metal fabrications as indicated on Drawings.

B. Related Requirements:

1. Section 057000 "Decorative Metal" for decorative items made primarily from plate, bars, extrusions, tubes, castings, and other forms of metal, but which may include sheet metal components.
2. Section 076000 “Sheet Metal Flashing and Trim” for items made of formed metal for flashings and trim.
3. Section 077101 "Manufactured Copings” for items made of formed metal for parapets and copings.

1.3 COORDINATION

A. Coordinate installation of anchorages for decorative formed metal items. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver items to Project site in time for installation.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product, including finishing materials.

B. Shop Drawings: Show fabrication and installation details for decorative formed metal.

1. Include plans, elevations, component details, and attachment details.
2. Indicate materials and profiles of each decorative formed metal member, fittings, joinery, finishes, fasteners, anchorages, and accessory items.

C. Samples for Verification: For each type of exposed finish required, prepared on 6-inch-square Samples of metal of same thickness and material indicated for the Work.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: For decorative formed metal elements that house items specified in other Sections. Show dimensions of housed items, including locations of housing penetrations and attachments, and necessary clearances.

B. Qualification Data: For fabricator.

C. Mill Certificates: Signed by stainless-steel manufacturers certifying that products furnished comply with requirements.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: A shop with not less than 10 years' experience regularly engaged in the fabrication of decorative formed metal that employs skilled workers who custom fabricate products similar to those indicated for this Project and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of products.

C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Build mockups for the following types of decorative formed metal:

a. First installation of repetitive decorative formed metal materials. For each repetitive decorative formed metal materials, build mockup of first installation of such decorative metal component.

2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver decorative formed metal products wrapped in protective coverings and strapped together in suitable packs or in heavy-duty cartons. Remove protective coverings before they stain or bond to finished surfaces.

B. Store products on elevated platforms in a dry location.

1.9 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls, columns, beams, and other construction contiguous with decorative formed metal by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Thermal Movements: For decorative formed metal outside of the conditioned building envelope, and/or interior decorative formed metal in direct sun, allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 SHEET METAL

A. General: Fabricate products from sheet metal without pitting, seam marks, roller marks, stains, discolorations, or other imperfections where exposed to view on finished units.

B. Aluminum Sheet: Flat sheet complying with ASTM B 209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties of not less than Alloy 5005-H32.

1. Minimum Thickness: 0.063 inches, unless otherwise indicated.

C. Stainless-Steel Sheet: ASTM A 240 or ASTM A 666, Type 304 (for interior use), Type 316 (for exterior use), stretcher-leveled standard of flatness.

1. Minimum Thickness: 0.050 inches, unless otherwise indicated.

2.3 MISCELLANEOUS MATERIALS

A. Gaskets: As required to seal joints in decorative formed metal and remain weathertight; as recommended in writing by decorative formed metal manufacturer.

1. ASTM D 1056, 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.

B. Sealants, Exterior: Elastomeric sealant complying with Section 079200 "Joint Sealants" and as recommended in writing by decorative formed metal manufacturer.

C. Sealants, Interior: Nonsag, paintable sealant complying with Section 079200 "Joint Sealants" and as recommended in writing by decorative formed metal manufacturer.

D. Filler Metal and Electrodes: Provide type and alloy of filler metal and electrodes as recommended by producer of metal to be welded or brazed and as necessary for strength, corrosion resistance, and compatibility in fabricated items.

1. Use filler metals that will match the color of metal being joined and will not cause discoloration.

E. Fasteners: Fabricated from same basic metal and alloy as fastened metal unless otherwise indicated. Do not use metals that are incompatible with materials joined.

1. Provide concealed fasteners for interconnecting decorative formed metal items and for attaching them to other work unless otherwise indicated or unless exposed fasteners are unavoidable or are the standard fastening method.
2. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.

F. Fasteners for Anchoring to Other Construction: Unless otherwise indicated, select fasteners of type, grade, and class required to produce connections suitable for anchoring indicated items to other types of construction indicated.

G. Sound-Deadening Materials:

1. Insulation: Unfaced, mineral-fiber blanket insulation complying with ASTM C 665, Type I, and passing ASTM E 136 test.
2. Mastic: Cold-applied asphalt emulsion complying with ASTM D 1187.

H. Backing Materials: Provided or recommended by decorative formed metal manufacturer.

I. Laminating Adhesive: Adhesive recommended by metal fabricator that will fully bond metal to metal, will prevent telegraphing and oil-canning, and is compatible with substrate and noncombustible after curing.

J. Isolation Coating: Manufacturer's standard bituminous paint.

2.4 MISCELLANEOUS MATERIALS

A. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble decorative formed metal items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Coordinate dimensions and attachment methods of decorative formed metal items with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned unless otherwise indicated.

C. Form metal to profiles indicated, in maximum lengths to minimize joints. Produce flat, flush surfaces without cracking or grain separation at bends. Fold back exposed edges of unsupported sheet metal to form a 1/2-inch-wide hem on the concealed side, or ease edges to a radius of approximately 1/32 inch and support with concealed stiffeners.

D. Increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as needed to provide surface flatness equivalent to stretcher-leveled standard of flatness and sufficient strength for indicated use.

1. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.

E. Build in straps, plates, and brackets as needed to support and anchor fabricated items to adjoining construction. Reinforce decorative formed metal items as needed to attach and support other construction.

F. Provide support framing, mounting and attachment clips, splice sleeves, fasteners, and accessories needed to install decorative formed metal items.

G. Where welding is indicated, weld joints and seams continuously. Grind, fill, and dress to produce smooth, flush, exposed surfaces in which joints are not visible after finishing is completed.

1. Use welding procedures that will blend with and not cause discoloration of metal being joined.

2.6 GENERAL FINISH REQUIREMENTS

A. Complete mechanical finishes of flat sheet metal surfaces before fabrication where possible. After fabrication, finish all joints, bends, abrasions, and other surface blemishes to match sheet finish.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.

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.

2.7 ALUMINUM FINISHES

A. High-Performance Organic Finish: Three-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: Custom color as indicated on Drawings, or if not indicated, to math Architect’s design reference sample.

2.8 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.

C. Directional Satin Finish: No. 4.

D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of decorative formed metal.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Locate and place decorative formed metal items level and plumb and in alignment with adjacent construction. Perform cutting, drilling, and fitting required to install decorative formed metal.

1. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where needed to protect metal surfaces and to make a weathertight connection.

C. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers as indicated.

D. Exterior Decorative Formed Metal: Install concealed gaskets, joint fillers, insulation, sealants, and flashings, as the Work progresses, to make exterior decorative formed metal items weatherproof.

E. Interior Decorative Formed Metal: Install concealed gaskets, joint fillers, sealants, and insulation, as the Work progresses, to make interior decorative formed metal items soundproof or lightproof as applicable to type of fabrication indicated.

F. Corrosion Protection: Apply bituminous paint or other permanent separation materials on concealed surfaces where metals would otherwise be in direct contact with substrate materials that are incompatible or could result in corrosion or deterioration of either material or finish.

3.3 CLEANING

A. Unless otherwise indicated, clean metals by washing thoroughly with water and soap, rinsing with clean water, and drying with soft cloths.

B. Clean copper alloys according to metal finisher's written instructions in a manner that leaves an undamaged and uniform finish matching approved Sample.

C. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

3.4 PROTECTION

A. Protect finishes of decorative formed metal items from damage during construction period. Remove temporary protective coverings at time of Substantial Completion.

END OF SECTION 057500

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Framing with dimension lumber.
2. Framing with timber.
3. Framing with engineered wood products.
4. Shear wall panels.
5. Rooftop equipment bases and support curbs.
6. Wood blocking, cants, and nailers.
7. Wood furring and grounds.
8. Wood sleepers.
9. Utility shelving.
10. Plywood backing panels.

B. Related Requirements:

1. Section 061600 "Sheathing" for sheathing, subflooring, and underlayment.

1.3 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.

B. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.

C. Exposed Framing: Framing not concealed by other construction.

D. OSB: Oriented strand board.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

B. Sustainable Design Submittals:

1. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each regional material.
2. Product Data: For composite wood products, indicating that product contains no urea formaldehyde.
3. Product Data: For installation adhesives, indicating VOC content.
4. Laboratory Test Reports: For installation adhesives, indicating compliance with requirements for low-emitting materials.

C. Fastener Patterns: Full-size templates for fasteners in exposed framing.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

B. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.
3. Engineered wood products.
4. Shear panels.
5. Power-driven fasteners.
6. Post-installed anchors.
7. Metal framing anchors.

1.6 QUALITY ASSURANCE

A. Framer Qualifications: A firm with not less than 10 years' experience framing rough carpentry similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance

B. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

C. Inspection Agencies: Inspection agencies, and the reference abbreviations include the following:

1. WCLIB: West Coast Lumber Inspection Bureau.
2. WWPA: Western Woods Products Association.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
3. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

C. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.

1. Allowable design stresses, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
2. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
3. Framing for exterior walls and roofs.
4. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.

1. Treatment shall not promote corrosion of metal fasteners.
2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
4. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D 5664 and design value adjustment factors shall be calculated according to ASTM D 6841. For enclosed roof framing, framing in attic spaces, and where high temperature fire-retardant treatment is indicated, provide material with adjustment factors of not less than 0.85 modulus of elasticity and 0.75 for extreme fiber in bending for Project's climatological zone.
5. Fire-retardant-treated lumber and plywood shall implement a treatment process that is also resistant to termite attack and decay when used in weather protected above ground applications.
6. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide fire-retardant-treated wood by the following:

    a. Hoover Treated Wood Products, Inc.; "Pyro-Guard plus."
    b. Or Comparable Equal.

C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.

E. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not bleed through, contain colorants, or otherwise adversely affect finishes.

F. Application: Treat items indicated on Drawings, and the following:

1. Framing for raised platforms.
2. Framing for stages.
3. Concealed blocking.
4. Framing for non-load-bearing partitions.
5. Framing for non-load-bearing exterior walls.
6. Roof construction.
7. Plywood backing panels.
8. Framing within a plenum.
9. In locations indicated and in compliance with the requirements of authorities having jurisdiction.

2.4 DIMENSION LUMBER FRAMING

A. Joists, Rafters, and Other Framing: Grade as specified.

1. Species: Douglas fir-larch; WCLIB or WWPA.

2.5 ENGINEERED WOOD PRODUCTS

A. Composite Wood Products: Products shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Source Limitations: Obtain each type of engineered wood product from single source from a single manufacturer.

C. Wood I-Joists: Prefabricated units, I-shaped in cross section, made with solid or structural composite lumber flanges and wood-based structural panel webs, let into and bonded to flanges. Comply with material requirements of and with structural capacities established and monitored according to ASTM D 5055.

1. Web Material: Either OSB or plywood, complying with DOC PS 1 or DOC PS 2, Exposure 1.
2. Structural Properties: Depths and design values not less than those indicated.
3. Comply with APA PRI-400. Factory mark I-joists with APA-EWS trademark indicating nominal joist depth, joist class, span ratings, mill identification, and compliance with APA-EWS standard.

D. Rim Boards: Product designed to be used as a load-bearing member and to brace wood I-joists at bearing ends, complying with research or evaluation report for I-joists.

1. Manufacturer: Provide products by same manufacturer as I-joists.
2. Material: All-veneer product, glued-laminated wood, or product made from any combination solid lumber, wood strands, and veneers.
3. Thickness: As indicated
4. Comply with APA PRR-401, rim board grade. Factory mark rim boards with APA-EWS trademark indicating thickness, grade, and compliance with APA-EWS standard.

2.6 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Cants.
5. Furring.
6. Utility shelving.

B. Dimension Lumber Items: any of the following species:

1. Western woods; WCLIB or WWPA.

C. Utility Shelving: Lumber with 19 percent maximum moisture content.

D. Concealed Boards: 19 percent maximum moisture content.

E. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

F. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

G. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.7 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

2.8 FASTENERS

A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC58, ICC-ES AC193 or ICC-ES AC308 as appropriate for the substrate.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

2.9 METAL FRAMING ANCHORS

A. Allowable design loads, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.

B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.

1. Use for interior locations unless otherwise indicated.

C. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.

1. Use for wood-preservative-treated lumber and where indicated.

D. Stainless-Steel Sheet: ASTM A 666, Type 304.

1. Use for exterior locations and where indicated.

E. Joist Hangers: U-shaped joist hangers with 2-inch-long seat and 1-1/4-inch-wide nailing flanges at least 85 percent of joist depth.

1. Thickness: As indicated.

F. I-Joist Hangers: U-shaped joist hangers with 2-inch-long seat and 1-1/4-inch-wide nailing flanges full depth of joist. Nailing flanges provide lateral support at joist top chord.

1. Thickness: As indicated.

G. Top Flange Hangers: U-shaped joist hangers, full depth of joist, formed from metal strap with tabs bent to extend over and be fastened to supporting member.

1. Strap Width: As indicated.
2. Thickness: As indicated.

H. Bridging: Rigid, V-section, nailless type, 0.050 inch thick, length to suit joist size and spacing.

I. Joist Ties: Flat straps, with holes for fasteners, for tying joists together over supports.

1. Width: As indicated.
2. Thickness: As indicated.
3. Length: As indicated.

2.10 MISCELLANEOUS MATERIALS

A. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to suit width of sill members indicated.

B. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chloropyrifos as its active ingredient.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

C. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.

E. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

F. Do not splice structural members between supports unless otherwise indicated.

G. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

H. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:

1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal thickness.
3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.
4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet o.c.

I. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

J. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

K. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).
2. ICC-ES evaluation report for fastener.

L. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

M. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.

1. Comply with indicated fastener patterns where applicable.
2. Use finishing nails unless otherwise indicated. Countersink nail heads and fill holes with wood filler.
3. Use common nails unless otherwise indicated. Drive nails snug but do not countersink nail heads.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 FLOOR JOIST FRAMING INSTALLATION

A. General: Install floor joists with crown edge up and support ends of each member with not less than 1-1/2 inches of bearing on wood or metal. Attach floor joists as follows:

1. Where supported on wood members, by using metal framing anchors.
2. Where framed into wood supporting members, by using wood ledgers as indicated or, if not indicated, by using metal joist hangers.

B. Fire Cuts: At joists built into masonry, bevel cut ends 3 inches and do not embed more than 4 inches.

C. Frame openings with headers and trimmers supported by metal joist hangers; double headers and trimmers where span of header exceeds 48 inches.

D. Do not notch in middle third of joists; limit notches to one-sixth depth of joist, one-third at ends. Do not bore holes larger than one-third depth of joist; do not locate closer than 2 inches from top or bottom.

E. Provide solid blocking of 2-inch nominal thickness by depth of joist at ends of joists unless nailed to header or band.

F. Lap members framing from opposite sides of beams, girders, or partitions not less than 4 inches or securely tie opposing members together. Provide solid blocking of 2-inch nominal thickness by depth of joist over supports.

G. Provide solid blocking between joists under jamb studs for openings.

H. Under non-load-bearing partitions, provide double joists separated by solid blocking equal to depth of studs above.

1. Provide triple joists separated as above, under partitions receiving ceramic tile and similar heavy finishes or fixtures.

I. Provide bridging of type indicated below, at intervals of 96 inches o.c., between joists.

1. Diagonal wood bridging formed from bevel-cut, 1-by-3-inch nominal-size lumber, double-crossed and nailed at both ends to joists.
2. Steel bridging installed to comply with bridging manufacturer's written instructions.

3.4 ERECTION TOLERANCES

A. Framing members which will be covered by finishes such as wallboard, plaster, or ceramic tile in a thick-set mortar setting bed, shall be within the following limits:

1. Layout of Walls and Partitions: 1/4 inch from intended position.
2. Plates and Runners: 1/4 inch in 10 feet from a straight line.
3. Studs: 1/4 inch in 10 feet out of plumb, non-cumulative, and
4. Face of Framing Members: 1/4 inch in 10 feet from a true plane.

B. Framing members which will be covered by ceramic tile set in thin-set mortar or organic adhesive shall be within the following limits:

1. Layout of Walls and Partitions: 1/4 inch from intended position.
2. Plates and Runners: 1/8 inch in 10 feet from a straight line.
3. Studs: 1/8 inch in 10 feet out of plumb, non-cumulative, and
4. Face of Framing Members: 1/8 inch in 10 feet from a true plane.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing:

1. Moisture Content of Building Materials: Building materials with visible signs of water damage shall not be installed. Wall and floor framing shall not be enclosed when the framing members exceed 19-percent moisture content. Moisture content shall be verified in compliance with the following:

   a. Moisture content shall be determined with either a probe-type or contact-type moisture meter. Equivalent moisture verification methods may be approved by the enforcing agency and shall satisfy requirements found in Section 101.8 of this code.
   b. Moisture readings shall be taken at a point 2 feet to 4 feet from the grade stamped end of each piece to be verified.
   c. At least three random moisture readings shall be performed on wall and floor framing with documentation acceptable to the enforcing agency provided at the time of approval to enclose the wall and floor framing.

C. If test results or inspections show sheathing does not comply with requirements:

1. Provide additional drying time to rough carpentry until rough carpentry installation passes, and/or
2. Remove and replace rough carpentry until rough carpentry installation passes.

D. Proceed with installation of adjacent construction (cladding, building wraps, gypsum board, etc.) only after unsatisfactory conditions have been corrected.

E. Prepare test and inspection reports.

3.6 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet enough that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Wall sheathing.
2. Roof sheathing.
3. Parapet sheathing.
4. Subflooring.
5. Underlayment.
6. Sheathing joint and penetration treatment.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for plywood backing panels.
2. Section 071326 "Self-Adhering Sheet Waterproofing" for air and waterproofing barrier applied over wall sheathing.

1.3 COORDINATION, SEQUENCING, AND SCHEDULING

A. Coordinate, sequence, and schedule sheathing installation with installation of materials installed over sheathing (waterproofing, roofing systems, flashing, etc.) so sheathing products are kept dry and are not exposed to precipitation or left exposed at end of the workday when rain is forecast.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
3. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5516.
4. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

B. Sustainable Design Submittals:

1. Product Data: For composite wood products, indicating that product contains no urea formaldehyde.
2. Product Data: For installation adhesives, indicating VOC content.

1.5 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated plywood.
2. Fire-retardant-treated plywood.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

B. Do not install panels that are defective, moisture damaged, mold damaged, and/or are excessively warped and would result work exceeding the installation tolerances specified in Section 061000 "Rough Carpentry."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: As tested according to ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

B. Sustainable Design (CALGreen): Adhesives and composite wood products shall comply with the following:

1. Adhesives: Adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers and caulks shall comply with local or regional air pollution control or air quality management district rules where applicable, or SCAQMD Rule 1168 VOC limits, as shown in 2016 CALGreen Tables 5.504.4.1 and 5.504.4.2. Such products also shall comply with the Rule 1168 prohibition on the use of certain toxic compounds (chloroform, ethylene dichloride methylene chloride, perchloroethylene and trichloroethylene). Adhesives shall have no added formaldehyde resins.
2. Composite Wood Products: Hardwood plywood and medium density fiberboard composite wood products used on the interior or exterior of the building shall meet the requirements for formaldehyde as specified in ARB's Air Toxics Control Measure (ATCM) for Composite Wood (17 CCR 93120 et seq.) Those materials not exempted under the ATCM must meet the specified emission limits, as shown in 2016 CALGreen Table 5.504.4.5.

2.2 WOOD PANEL PRODUCTS

A. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.

B. Factory mark panels to indicate compliance with applicable standard.

2.3 WALL SHEATHING

A. Glass-Mat Gypsum Sheathing: ASTM C 1177.

1. Basis-of-Design Product: Subject to compliance with requirements, provide glass-mat gypsum sheathing by the following:

a. Georgia Pacific, Inc.; "DensGlass Sheathing."

2. Type and Thickness: Type X, 5/8 inch thick.
3. Size: 48 by 96 inches for vertical installation.

B. Cementitious Backer Units: ANSI A118.9 or ASTM C 1325, Type A, in maximum lengths available to minimize end-to-end butt joints.

1. Thickness: 5/8 inch, unless otherwise indicated.
2. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
3. Approved for exterior use in accordance with ICC-ES AC 376.
4. Shear Bond Strength: greater than or equal to 200 psi, when tested in accordance with ANSI 118.4.
5. Core consisting of cement, polystyrene beads and aggregates. Both faces to have embedded fiberglass mesh.
6. Moisture absorption of less than 8 percent when tested in accordance with ASTM C 473.
7. Face Finish:

a. Exposed Face: Cementitious finish.
b. Unexposed Face: Smooth finish.

2.4 ROOF SHEATHING

A. Plywood Sheathing: As indicated.

1. Span Rating: As indicated.
2. Nominal Thickness: As indicated.

2.5 PARAPET SHEATHING

A. Glass-Mat Gypsum Sheathing: ASTM C 1177.

1. Type and Thickness: Type X, 5/8 inch thick.
2. Size: 48 by 96 inches for vertical installation.

2.6 SUBFLOORING AND UNDERLAYMENT

A. Plywood Subflooring: As indicated.

1. Span Rating: As indicated.
2. Nominal Thickness: As indicated.

B. Underlayment: Provide underlayment in nominal thicknesses indicated or, if not indicated, not less than 3/8-inch thickness over subfloors.

1. Plywood Underlayment for Resilient Flooring: DOC PS 1, Exterior, C-C Plugged with fully sanded face.
2. Underlayment for Ceramic Tile: Cementitious backer units per Section 092900 "Gypsum Board."
3. Plywood Underlayment for Carpet: DOC PS 1, Exterior, C-C Plugged Exposure 1, Underlayment.

2.7 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. For roof and parapet sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Screws for Fastening Sheathing to Wood Framing: ASTM C 1002.

E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

F. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.

1. For steel framing less than 0.0329 inch thick, use screws that comply with ASTM C 1002.
2. For steel framing from 0.033 to 0.112 inch thick, use screws that comply with ASTM C 954.

G. Screws for Fastening Composite Nail Base Insulated Roof Sheathing to Metal Roof Deck: Steel drill screws, in type and length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117. Provide washers or plates if recommended by sheathing manufacturer.

2.8 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

A. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.

1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches wide, 10 by 10 or 10 by 20 threads/inch, of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

2.9 MISCELLANEOUS MATERIALS

A. Adhesives for Field Gluing Panels to Wood Framing: Formulation complying with ASTM D 3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

1. Adhesive shall have a VOC content of 50 g/L or less.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
2. ICC-ES evaluation report for fastener.

D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

E. Coordinate wall, parapet, and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:

1. Roof Sheathing:

a. Nail to wood framing.
b. Space panels 1/8 inch apart at edges and ends.
c. At roof sheathing, all joints between plywood shall be blocked with wood framing.
d. Comply with additional requirements in Division 07 Roofing Section(s).

2. Subflooring:

a. Glue and mechanically fasten (screw or nail with deformed shank nails) to wood framing.
b. Space panels 1/8 inch apart at edges and ends.

3. Underlayment:

a. Nail (with deformed shank nails) to subflooring.
b. Space panels 1/32 inch apart at edges and ends.
c. Fill and sand edge joints of underlayment receiving resilient flooring immediately before installing flooring.

3.3 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.

1. Fasten gypsum sheathing to wood framing with screws.
2. Fasten gypsum sheathing to cold-formed metal framing with screws.
3. Install panels with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
4. Install panels with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.

C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent panels without forcing. Abut ends over centers of studs, and stagger end joints of adjacent panels not less than one stud spacing. Attach at perimeter and within field of panel to each stud.

1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of panels.
2. For sheathing under stucco cladding, panels may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.

D. Vertical Installation: Install vertical edges centered over studs. Abut ends and edges with those of adjacent panels. Attach at perimeter and within field of panel to each stud.

1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of panels.
2. For sheathing under stucco cladding, panels may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.

E. Seal sheathing joints according to sheathing manufacturer's written instructions.

1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

3.4 CEMENTITIOUS BACKER SHEATHING INSTALLATION

A. Fasten cementitious backer boards horizontally or vertically through sheathing into framing.

1. Penetrate steel studs a minimum of 3/8 inch with fastener.
2. Space fasteners 8 inches on center maximum along perimeter and in field of cement board unless noted otherwise.
3. Place fasteners a minimum of 3/8 inch and a maximum of 5/8 inch from the cement board edge.
4. Drive fastener heads flush with the face of the cement board.

B. Stagger vertical joints of the cement board. Locate joints over framing members.

C. Offset horizontal joints in cement board a minimum of 12 inches from horizontal joints in sheathing.

D. Offset vertical joints in cement board a minimum of one stud space from vertical joints in sheathing.

E. Offset joints in cement board a minimum of 8 inches from the corners of openings by "L" cutting cement board around openings.

F. Treat cement board joints and corners with 4” wide alkali-resistant fiberglass mesh tape imbedded in mortar specified in Section 044313 "Exterior Adhered Tile Veneer." Allow the taping treatment to cure for 12 to 24 hours at 70-deg F.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing:

1. Moisture Content of Building Materials: Building materials with visible signs of water damage shall not be installed. Wall and floor framing shall not be enclosed when the framing members exceed 19-percent moisture content. Moisture content shall be verified in compliance with the following:

a. Moisture content shall be determined with either a probe-type or contact-type moisture meter. Equivalent moisture verification methods may be approved by the enforcing agency and shall satisfy requirements found in Section 101.8 of this code.
b. Moisture readings shall be taken at a point 2 feet to 4 feet from the grade stamped end of each piece to be verified.
c. At least three random moisture readings shall be performed on wall and floor framing with documentation acceptable to the enforcing agency provided at the time of approval to enclose the wall and floor framing.

C. If test results or inspections show sheathing does not comply with requirements:

1. Provide additional drying time to sheathing until sheathing installation passes, and/or
2. Remove and replace sheathing until sheathing installation passes.

D. Proceed with installation of adjacent construction (cladding, building wraps, gypsum board, etc.) only after unsatisfactory conditions have been corrected.

E. Prepare test and inspection reports.

3.6 PROTECTION

A. Where sheathing acts as a substrate for a roofing system or air/weather barrier system, protect sheathing from climatic conditions to prevent moisture / weather damage until the installation of the roof or air/ weather barrier system.

B. Remove and replace sheathing panels that are defective, moisture damaged, mold damaged, and/or panels that are excessively warped and would result in work exceeding the installation tolerances specified in Section 061000 "Rough Carpentry."

END OF SECTION 061600

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Wood-veneer-faced architectural cabinets for transparent finish.
2. Plastic-laminate-faced architectural cabinets.
3. Flush wood paneling for transparent finish.
4. Interior standing and running trim for transparent finish.
5. Interior architectural woodwork for transparent finish.
6. Wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.
7. Shop finishing of interior woodwork.

B. Related Requirements:

1. Section 057000 “Decorative Metals” for decorative metals to be incorporated into interior architectural woodwork.
2. Section 061000 “Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing woodwork and concealed within other construction before woodwork installation.
3. Section 088000 “Glazing” for glazing products to be incorporated in woodwork.
4. Division 12 Section(s) for countertops.

1.3 DEFINITIONS

A. AWS: Architectural Woodwork Standards.

B. BHMA: Builder’s Hardware Manufacturer’s Association.

C. WI: Woodwork Institute.

1.4 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that woodwork can be supported and installed as indicated.

B. Hardware Coordination: Distribute copies of approved hardware schedule specified in Section 087100 “Door Hardware” to fabricator of interior architectural woodwork; coordinate Shop Drawings and fabrication with hardware requirements.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product, including panel products and finishing materials and processes.

B. Sustainable Design Submittals: Include documentation that adhesives and composite wood products are in compliance with “Performance Requirements” article.

C. Shop Drawings: Provide project-specific shop drawings for interior architectural woodwork.

1. Include plans, elevators, sections, and attachment details.
2. Show large-scale details.
3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
4. Show locations and sizes of cutouts for holes for items installed in interior architectural woodwork.
5. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.
6. Apply WI Certified Compliance Program label to Shop Drawings.

D. Samples for Verification:

1. Lumber for transparent finish, not less than 5 inches wide by 12 inches long, for each species and cut, finished on one side and one edge.
2. Veneer leaves representative of and selected from flitches to be used for transparent finished woodwork.
3. Veneer-faced panel products with or for transparent finish, 8 by 10 inches, for each species and cut.
4. Plastic laminates, 8 by 10 inches, for each type, color, pattern, and surface finish, with one sample applied to core material and specified edge material applied to one edge.
5. Exposed cabinet hardware and accessories, one unit for each type and finish.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

B. Product Certificates: For the following:

1. High-pressure decorative laminate.
2. Composite wood products.
3. Adhesives.

C. Woodwork Quality Standard Compliance Certificates: WI Certified Compliance Program certificates.

D. At Substantial Completion, provide WI Certificate of Compliance for all casework and materials installed.

E. Field quality control reports.

1.8 QUALITY ASSURANCE

A. Fabricator/Installer Qualifications: A shop with not less than 10 years’ experience regularly engaged in the fabrication of interior architectural woodwork that employs skilled workers who custom fabricate products similar to those indicated for this Project and whose products have a record of successful in-service performance. Shop is also a certified participant in WI’s Quality Certification Program.

B. Certified Compliance:

1. Provide a WI Certificate of Compliance indicating that all casework meets the requirements of the AWS, the plans and specifications.
2. Apply a WI Certificate of Compliance Label to each section of casework.
3. On completion of installation, provide a WI Certified Compliance Certificate for the installation.
4. All WI Certified Compliance fees are the responsibility of the casework manufacturer.

C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups of each typical type cabinet as shown on Drawings.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver interior woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.10 FIELD CONDITIONS

A. Environmental Limitations for Interior Work: Do not deliver or install interior woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.

C. Established Dimensions: Where woodwork is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of woodwork indicated for construction, finishes, installation, and other requirements.

1. Provide labels and certificates from WI certification program indicating that woodwork, including installation, complies with requirements of grades specified.
2. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.
3. System Structural Performance: Cabinets and support framing shall withstand the effects of gravity loads and stresses without permanent deformation, excessive deflection, or binding of doors.
4. Seismic Performance: Comply with the Woodwork Institute's Certified Seismic Installation Program:

a. All wood or metal frame wall construction shall be constructed with continuous in-wall blocking of either 3x6 Douglas Fir or 16-gauge by 6-inch wide, 50 KSI sheet metal provided in accordance with the location requirements included on the cabinet fabricator/installer's shop drawings.
b. All casework installation shall be certified by the Woodwork Institute in accordance with their Certified Seismic Installation Program (CSIP), including:

1) CSIP certificate indicating that all of the casework installation fully meets the requirements of the AWS, CSIP and WI's preapprovals.

c. It is the responsibility of the installer to include with their bid, any and all costs for WI's CSIP certification. Certification is a prerequisite for final acceptance.

B. Grade of Woodwork:

1. Plastic Laminate Cabinets: Custom.
2. All Other Woodwork: Premium.

C. Sustainable Design: Adhesives and composite wood products shall comply with 2016 CALGreen mandatory measures:

1. Adhesives: Adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers and caulks shall comply with local or regional air pollution control or air quality management district rules where applicable, or SCAQMD Rule 1168 VOC limits, as shown in 2016 CALGreen Tables 5.504.4.1 and 5.504.4.2. Such products also shall comply with the Rule 1168 prohibition on the use of certain toxic compounds (chloroform, ethylene dichloride methylene chloride, perchloroethylene and trichloroethylene). Adhesives shall have no added formaldehyde resins.
2. Composite Wood Products: Hardwood plywood and medium density fiberboard composite wood products used on the interior or exterior of the building shall meet the requirements for formaldehyde as specified in ARB's Air Toxics Control Measure (ATCM) for Composite Wood (17 CCR 93120 et seq.) Those materials not exempted under the ATCM must meet the specified emission limits, as shown in 2016 CALGreen Table 5.504.4.5.

D. Fire-Test-Response Characteristics (Plastic Laminates): As determined by testing identical plastic laminate applied with identical adhesives to substrates according to test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

a. Flame-Spread Index: 75 or less.
b. Smoke-Developed Index: 450 or less.

2.2 FABRICATOR

A. Fabricator: Subject to compliance with requirements, fabricator shall be a licensee of the Woodwork Institute Certified Compliance Program and Certified Seismic Installation Program.

B. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of work specified herein.

2.3 WOOD-VENEER-FACED ARCHITECTURAL CABINETS FOR TRANSPARENT FINISH

A. Type of Construction: As indicated on Drawings, or if not indicated, frameless.

B. Cabinet and Door and Drawer Interface Style: As indicated, or if not indicated, flush overlay.

C. Wood for Exposed Surfaces:

1. Species: As indicated on Drawings.
2. Cut: As indicated on Drawings, or if not indicated, quarter cut/quarter sawn.
3. Grain Direction: As indicated, or if not indicated, vertically for drawer fronts, doors, and fixed panels.
4. Matching of Veneer Leaves: Book.

D. Semiexposed Surfaces: Provide surface materials indicated below:

1. Surfaces Other than Drawer Bodies: Same species and cut indicated for exposed surfaces.
2. Drawer Subfronts, Backs, Sides: Solid-hardwood lumber, same species indicated for exposed surfaces.
3. Drawer Bottoms: Hardwood plywood.

E. Dust Panels: 1/4-inch plywood or tempered hardboard above compartments and drawers, unless located directly under tops.

F. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

2.4 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

A. Type of Construction: As indicated on Drawings, or if not indicated, frameless.

B. Cabinet, Door, and Drawer Interface Style: As indicated, or if not indicated, flush overlay.

C. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by woodwork quality standard.

1. Basis-of-Design Products: As indicated on Drawings.

D. Laminate Cladding for Exposed Surfaces:

1. Horizontal Surfaces: Grade HGS.
2. Vertical Surfaces: Grade HGS.
3. Edges: Grade HGS.
4. Pattern Direction: Vertically for doors and fixed panels.

E. Materials for Semiexposed Surfaces:

1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, Grade VGS.

a. Edges of Plastic-Laminate Shelves: PVC tape, 0.018-inch minimum thickness, matching laminate in color, pattern, and finish.
b. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade VGS.

1. Drawer Sides and Backs: Solid-hardwood lumber.
2. Drawer Bottoms: Hardwood plywood.

F. Dust Panels: 1/4-inch plywood or tempered hardboard above compartments and drawers unless located directly under tops.

G. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.

H. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

I. Plastic-Laminate Shelves: Plastic laminate shop bonded to both faces and all edges of 1-inch-thick core. Sand surfaces to which plastic laminate is to be bonded.

1. Shelf Core: Exterior plywood.
2. Plastic-Laminate Grade for Shelves: HGL.

2.5 FLUSH WOOD PANELING FOR TRANSPARENT FINISH

A. Wood Species: As indicated on Drawings.

B. Cut: As indicated on Drawings, or if not indicated, quarter cut/quarter sawn.

C. Matching of Adjacent Veneer Leaves: Book match.

D. Matching within Panel Face: Running.

E. Panel Core Construction: Hardwood veneer-core plywood.

F. Assemble panels by gluing and concealed mechanical fastening.

2.6 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

A. Interior standing and running trim for transparent finish includes the following:

1. Wood base.
2. As indicated on Drawings.

B. Wood Species: As indicated on Drawings.

C. Cut: As indicated on Drawings, or if not indicated, quarter cut/quarter sawn.

D. For trim items other than base wider than available lumber, use veneered construction. Do not glue for width.

1. For veneered base, use hardwood lumber core, glued for width.

E. For base wider than available lumber, glue for width. Do not use veneered construction.

F. For rails thicker than available lumber, use veneered construction. Do not glue for thickness.

2.7 INTERIOR ARCHITECTURAL WOODWORK FOR TRANSPARENT FINISH

A. Interior architectural woodwork for transparent finish includes the following:

1. As indicated on Drawings.

B. Wood Species and Cut:

1. Species: As indicated.
2. Cut: As indicated, or if not indicated, quarter cut/quarter sawn.

2.8 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than 3 inches wide.
2. Wood Moisture Content for Interior Materials: 8 to 13 percent.

B. Composite Wood Products: Provide materials that comply with “Performance Requirements” article and with requirements of referenced quality standard below for each type of woodwork and quality grade specified unless otherwise indicated.

1. Medium-Density Fiberboard: ANSI A208.2, Grade 130.
2. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.

2.9 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with WI grade architectural cabinets.

B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602. Provide three for doors more than 48 inches high.

C. Pulls: As indicated on Drawings, or if not indicated, back-mounted, solid metal wire pulls, 4 inches long, 5/16 in diameter.

D. Catches: Roller catches, BHMA A156.9, B03071.

E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.

F. Drawer Slides: BHMA A156.9.

G. Locks: Cam type complying with BHMA A156.11 Type E07281.

1. Provide locks on all cabinets and drawers, whether indicated or not.
2. Quantity: Minimum of ten keys per lock and two master keys.
3. Unless otherwise indicated, all locks shall be keyed alike.

H. Door and Drawer Silencers: BHMA A156.16, L03011.

I. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

1. As indicated on Drawings, or if not indicated, stainless steel.

J. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.10 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. .Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

C. Installation Adhesive: Product recommended by fabricator for each substrate for secure anchorage.

2.11 FABRICATION

A. Fabrication shall comply with AWS requirements.

B. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges and corners to 1/16-inch radius unless otherwise indicated.

C. Complete fabrication, including assembly and finishing, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

D. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

E. Backout or groove backs of flat trim members and kerf backs of other wide, flat members except for members with ends exposed in finished work.

F. Form decorative metal to required shapes and sizes, true to line and level with true curves and accurate angles and surfaces. Finish exposed surfaces to smooth, sharp, well-defined lines. Mill joints to a tight, hairline fit. Cope or miter corners.

G. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

2.12 SHOP FINISHING

A. General: Finish woodwork at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

B. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing woodwork, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of cabinets.

C. Transparent Finish for Interior Items:

1. Grade: Premium.
2. Finish: System - 11, catalyzed polyurethane.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Fabricator present, for compliance with requirements for installation tolerances, location of reinforcements, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas for not less than 72 hours.

B. Before installing woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.3 INSTALLATION

A. Grade: Install woodwork to comply with same grade as item to be installed.

B. Assemble woodwork and complete fabrication at Project site to the extent that it was not completed in the shop.

C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.

1. For shop-finished items, use filler matching finish of items being installed.

F. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than 36 inches long except where shorter single-length pieces are necessary. Scarf running joints and stagger in adjacent and related members.

1. Fill gaps, if any, between top of base and wall with latex sealant, painted to match wall.
2. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches.

G. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners.

1. Use filler matching finish of items being installed.

H. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches using concealed shims.

1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
3. Maintain veneer sequence matching of cabinets with transparent finish.
4. Fasten wall cabinets to structure in accordance with “Performance Requirements” article, but no less than the following:

a. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with minimum No. 14 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

I. Shop Finishes: Touch up finishing after installation of architectural cabinets. Fill nail holes with matching filler.

1. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are applied in shop.

3.4 FIELD QUALITY CONTROL

A. Provide Woodwork Institute Certified Seismic Installation Program inspection reports and certification.

3.5 REPAIR, CLEANING, AND PROTECTION

A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

D. Protection: Protect woodwork during remainder of construction period so that woodwork is without damage or deterioration at time of Substantial Completion.

END OF SECTION 064023

SECTION 070150 - PARTIAL ROOF REMOVAL AND REPLACEMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Removal of existing roofing system and replacement with new roofing system at the following locations:

a. At juncture of new exterior wall improvements and existing roof.
b. Where indicated.

2. Transition from new roofing system to existing roofing.
3. Temporary roofing and protection of existing roofing to remain.

B. Related Requirements:

1. Section 011000 "Summary" for use of the premises, general work restrictions, and Owner work restrictions.
2. Section 015000 "Temporary Facilities and Controls" for temporary construction and environmental-protection measures for reroofing preparation.
3. Section 017300 “Execution” for cutting and patching procedures.
4. Section 076200 "Sheet Metal Flashing and Trim" for roof flashing to the extent not provided as part of this Section.

1.3 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.

B. New Roofing System: New roofing system is defined to include the following, whether indicated or not on the Drawings, and complying with specified performance requirements:

1. New roof membrane to match existing roof membrane.

a. Where existing roofing is no longer under warranty and product(s) are no longer available, provide new roofing of same general type and construction as existing roof system.

2. New insulation to match existing insulation, in type, thickness, and R-value.
3. New substrate and cover boards.
4. New flashings, adhesives, fasteners, and accessories.

1.4 PREINSTALLATION MEETINGS

A. Roof Removal and Replacement Conference: Conduct conference at Project site.

1. Meet with General Contractor; Architect; Owner representative and Owner’s insurer if applicable; roofing system manufacturer's representative; roofing Installer, including project manager, superintendent, and foreman; and installers whose work interfaces with or affects reroofing, including installers of roofing membrane and flashings, roof accessories, and roof-mounted equipment.

2. Review methods and procedures related to roofing system tear-off and replacement, including, but not limited to, the following:

    a. Reroofing preparation, including roofing system manufacturer's written instructions.
    b. Temporary protection requirements for existing roofing system components that are to remain.
    c. Existing roof drains and roof drainage during each stage of reroofing, and roof-drain plugging and plug removal.
    d. Construction schedule and availability of materials, Installer's personnel, equipment, and facilities needed to avoid delays.
    e. Existing roof deck conditions requiring notification of Architect.
    f. Existing roof deck removal procedures and Owner notifications.
    g. Condition and acceptance of existing roof deck and base flashing substrate for reuse.
    h. Structural loading limitations of roof deck during reroofing.
    i. Base flashings, special roofing details, drainage, penetrations, equipment curbs, and condition of other construction that affect reroofing.
    j. HVAC shutdown and sealing of air intakes.
    k. Shutdown of fire-suppression, -protection, and -alarm and -detection systems.
    l. Governing regulations and requirements for insurance and certificates if applicable.
    m. Existing conditions that may require notification of Owner and Architect before proceeding.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Temporary Roofing Submittal: Product data and description of temporary roofing system.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1. Include certificate that Installer is approved by warrantor of existing roofing system, or if not applicable, by manufacturer of new roofing system.

B. Field Test Reports: Fastener pull-out test report.

C. Photographs: Show existing conditions of adjoining construction and site improvements, including exterior and interior finish surfaces that might be misconstrued as having been damaged by reroofing operations. Submit before Work begins.

D. Field quality control reports.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 20 years' experience regularly engaged in the production and sales of new roofing systems which match the existing roofing system, that have been used for similar applications with successful results, that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports. Manufacturer shall have factory-authorized service representatives who are available for consultation, periodic Project-site observations, and on-site assistance.

B. Installer Qualifications: A firm with not less than 10 years' experience installing new roofing systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section. If existing roof membrane is under warranty, installer shall be licensed and eligible to receive manufacturer's special warranty.

C. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

1.8 FIELD CONDITIONS

A. Survey of Existing Roof Conditions: Record existing conditions that affect the Work by use of measured drawings, preconstruction photographs. Conduct survey with Architect and Owner's representative in field prior to any new work.

1. Confirm if existing roofing system is under warranty.

B. Protect building to be reroofed, adjacent buildings, walkways, site improvements, exterior plantings, and landscaping from damage or soiling from reroofing operations.

C. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.

D. Confirm construction loads imposed on roof with Structural Engineer, and no greater than the following: 300 pounds for rooftop equipment wheel loads and 20 pounds per square foot for uniformly distributed loads.

E. Weather Limitations: Proceed with reroofing preparation only when existing and forecasted weather conditions permit Work to proceed without water entering existing roofing system or building.

1. Remove only as much roofing in one day as can be made watertight in the same day.

F. All components used in roofing system must be protected from exposure to moisture before, during, and after installation.

G. Do not install roofing materials that are wet, moisture damaged, and/or mold damaged.

H. Hazardous Materials: Hazardous materials are not expected to be encountered in the Work.

1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Owner who will have materials tested. Allow three days when no work will be allowed while suspected hazardous materials are being tested.

I. Termite Infestation: It is not expected that active termite infestations will be encountered in the Work.

1. If active termite infestations are encountered, do not disturb; immediately notify the Owner who will have the infestations investigated. Allow three days when no work will be allowed on those portions of the Work suspected of having active termite infestations.

1.9 WARRANTY

A. Existing Warranties: Confirm with Owner if existing roof is under warranty. Upon confirmation, remove, replace, patch, and repair materials and surfaces cut or damaged during reroofing, by methods and with materials so as not to void existing roofing system warranty.

1. Notify warrantor before proceeding with the Work.
2. Notify warrantor of existing roofing system on completion of reroofing, and obtain documentation verifying that existing roofing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: New roofing system, including installed roofing membranes, base flashings, and accessories shall withstand minimum code-prescribed uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing and base flashings shall remain watertight.

B. Material Compatibility: Roofing materials shall be compatible with one another and under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.

C. New Roofing System Design: Provide roofing membrane system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to comply with the requirements of the 2016 California Building Code.

2.2 TEMPORARY PROTECTION MATERIALS

A. Design and selection of materials for temporary roofing are Contractor's responsibility.

B. Sheathing Paper: Red-rosin type, minimum 3 lb/100 sq. ft..

C. Base Sheet: ASTM D 4601, Type II, nonperforated, asphalt-impregnated and -coated, glass-fiber sheet.

D. Glass-Fiber Felts: ASTM D 2178, Type IV, asphalt-impregnated, glass-fiber felt.

E. Asphalt Primer: ASTM D 41.

F. Roofing Asphalt: ASTM D 312, Type III or IV.

G. Base Sheet Fasteners: Capped head, factory-coated steel fasteners, listed in FM Approvals' RoofNav.

2.3 REPLACEMENT MATERIALS

A. Use replacement materials matching existing roofing system materials unless otherwise indicated.

1. Where existing roofing is no longer under warranty and product(s) are no longer available, provide new roofing of same general type and construction as existing roof system.
2. For built-up roofing system, comply with ASTM D 4897, ASTM D 2178, and ASTM D 6164 as applicable.
3. Vapor Barrier: Matching existing, as applicable.

B. Wood Blocking, Curbs, and Nailers: Pressure-preservative treated.

C. Plywood: Pressure-preservative-treated plywood roof sheathing complying with Section 061600 "Sheathing."

D. Substrate Board: ASTM C 1278, cellulosic-fiber-reinforced, water-resistant gypsum substrate, minimum 1/2 inch thickness.

E. Miscellaneous Rough Carpentry: Pressure-preservative-treated lumber as specified in Section 061000 "Rough Carpentry."

F. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2.

1. Provide in thickness indicated, or if not indicated, in thickness matching existing insulation. Where insulation thickness exceeds 2 inches, provide in multiple layers not exceeding 2 inch thick each.
2. Maximum Size: 4 feet by 4 feet.

G. Tapered Insulation: Provide factory-tapered insulation boards fabricated to a slope of no less than 1/4 inch per foot unless otherwise indicated.

H. Cover Board: ASTM C 1278, cellulosic-fiber-reinforced, water-resistant gypsum substrate, in thickness recommended by roofing manufacturer.

I. Miscellaneous Accessories: Provide sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, lap sealants, termination reglets, and other accessories.

J. Metallic-Coated Steel Sheet (Galvanized) Flashing: Provide zinc-coated (galvanized) steel sheet in accordance with ASTM A 653, G90 coating designation.

1. Surface: Smooth, flat.
2. Thickness: Minimum 0.028 inch thick.
3. Galvanized sheet steel shall be limited to rooftop applications only, that are not in contact with concrete, and that are not visible from any vantage point on the site, nor visible from any public or guest vantage point from within the building or site.
4. Round Flashings Only: Provide roofing manufacturer's prefabricated pipe boot penetration flashings compatible with base membrane.
5. Pitch pans are not acceptable for use as penetration flashings for this Project.

K. Provide preformed saddles, crickets, tapered edge strips, tapered insulation, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated, or if not indicated, to confirm to existing slopes with a minimum slope of 1/4 inch per foot.

L. Adhesives: As recommended by manufacturer and complying with performance requirements.

M. Fasteners: Factory-coated steel fasteners with metal or plastic plates listed in FM Approvals' RoofNav, and acceptable to new roofing system manufacturer.

2.4 AUXILIARY ROOFING MATERIALS

A. General: Use auxiliary reroofing preparation materials recommended by roofing system manufacturer for intended use and compatible with components of existing and new roofing system.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protection of In-Place Conditions:

1. Protect existing roofing system that is not to be reroofed.
2. Loosely lay 1-inch-minimum thick, EPS insulation over existing roofing in areas not to be reroofed.

    a. Loosely lay 15/32-inch plywood over EPS. Extend EPS past edges of plywood panels a minimum of 1 inch.

3. Limit traffic and material storage to areas of existing roofing that have been protected.
4. Maintain temporary protection and leave in place until replacement roofing has been completed. Remove temporary protection on completion of reroofing.
5. Comply with requirements of existing roof system manufacturer's warranty requirements.

B. Seal or isolate windows that may be exposed to airborne substances created in removal of existing materials.

C. Subject to Owner approval, shut off rooftop utilities and service piping before beginning the Work.

D. Test existing roof drains to verify that they are not blocked or restricted.

1. Immediately notify the Owner of any blockages or restrictions.

E. Protect existing roofing system that is not to be reroofed.

1. Loosely lay 1-inch-minimum thick, expanded polystyrene (EPS) insulation over existing roofing in areas indicated. Loosely lay 15/32-inch plywood panels over EPS. Extend EPS past edges of plywood panels a minimum of 1 inch.
2. Limit traffic and material storage to areas of existing roofing that have been protected.
3. Maintain temporary protection and leave in place until replacement roofing has been completed. Remove temporary protection on completion of reroofing.

F. Coordinate with Owner to shut down air-intake equipment in the vicinity of the Work.

1. Cover air-intake louvers before proceeding with reroofing work that could affect indoor air quality or activate smoke detectors in the ductwork.

G. During removal operations, have sufficient and suitable materials on-site to facilitate rapid installation of temporary protection in the event of unexpected rain.

H. Maintain roof drains in functioning condition to ensure roof drainage at end of each workday.

1. Prevent debris from entering or blocking roof drains and conductors.

a. Use roof-drain plugs specifically designed for this purpose.
b. Remove roof-drain plugs at end of each workday, when no work is taking place, or when rain is forecast.

2. If roof drains are temporarily blocked or unserviceable due to roofing system removal or partial installation of new roofing system, provide alternative drainage method to remove water and eliminate ponding.

a. Do not permit water to enter into or under existing roofing system components that are to remain.

3.2 PARTIAL ROOF TEAR-OFF

A. Partial Roof Tear-Off: Where indicated, and where required for new construction, remove existing roofing and insulation and immediately check for presence of moisture by visually observing substrate that is to remain.

1. Remove wet or damp materials below existing roofing and above deck.
2. Inspect wood blocking, curbs, and nailers for deterioration and damage. If wood blocking, curbs, or nailers have deteriorated, immediately notify Owner and Architect.
3. Bitumen and felts that are firmly bonded to concrete decks are permitted to remain if felts are dry. Remove unadhered bitumen, unadhered felts, and wet felts.
4. Remove excess asphalt from deck that is exposed by removal of wet or damp materials.
5. Remove fasteners from deck.

3.3 DECK PREPARATION

A. Inspect deck after tear-off of roofing system.

B. Verify that roof substrate is visibly dry and free of moisture. Test for moisture by method recommended by roofing manufacturer. Do not proceed with roofing work if moisture content does not comply with manufacturer's written instructions.

C. If broken or loose fasteners that secure deck panels to one another or to structure are observed, or if deck appears or feels inadequately attached, immediately notify Owner and Architect. Do not proceed with installation until directed by Architect and Construction Manager.

D. If deck surface is unsuitable for receiving new roofing or if structural integrity of deck is suspect, immediately notify the Owner. Do not proceed with installation until directed by the Owner.

3.4 TEMPORARY ROOFING

A. Install temporary roofing over area to be reroofed.

B. Remove temporary roofing before installing new roofing.

3.5 NEW ROOFING SYSTEM INSTALLATION

A. Immediately after roof tear-off, fill in tear-off areas with new roofing system, including new roofing membrane, flashings, and all accessories to create a watertight system.

B. Install new roofing infill material to match existing adjacent roofing and tie into existing roofing. Comply with manufacturer's written instructions.

1. Where existing roofing is no longer under warranty and product(s) are no longer available, provide new roofing of same general type and construction as existing roof system. Install replacement roofing in accordance with manufacturer's written instructions.

C. New roofing system shall be installed to confirm to slopes indicated, or if not indicated, to conform to existing slopes with a minimum slope of 1/4 inch per foot. Install saddles, crickets, and tapered insulation in accordance with manufacturer's written installation instructions.

3.6 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

B. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof.

3.7 FASTENER PULL-OUT TESTING

A. Perform fastener pull-out tests according to SPRI FX-1, and submit test report to Owner and Architect before installing new roofing system.

3.8 FIELD QUALITY CONTROL (BY CONTRACTOR)

A. Manufacturer's Field Services: Manufacturer's technical representative shall provide technical assistance and guidance for preparation and application of new roofing system. At a minimum, arrange for manufacturer's technical representative to observe roofing removal, inspect substrate conditions, surface preparation, and initial installation of new roofing system; at mid-point of the installation; and at completion. Provide additional field observations as required by manufacturer and when requested by Architect or Owner. After each field visit, submit manufacturer's written report of observations within 3 working days. The report shall note overall quality of work, deficiencies, any other concerns, and recommended corrective action.

B. Flood Testing: Flood test each roof replacement area for leaks, according to recommendations in ASTM D 5957, after completing roofing and flashing but before placing overlying construction. Install temporary containment assemblies, plug or dam drains, and flood with potable water.

1. Flood to an average depth of 2-1/2 inches with a minimum depth of 1 inch and not exceeding a depth of 4 inches. Maintain 2 inches of clearance from top of base flashing.

a. Obtain Structural Engineer's written approval for each proposed test area and water depth prior to testing. If proposed test area is not structurally acceptable, perform flood testing on multiple smaller areas that are acceptable to structural engineer.

2. Flood each area for duration as required per ASTM D 5957, but no less than 24 hours.
3. After flood testing, repair leaks, repeat flood tests, and make further repairs until roofing and flashing installations are watertight.

C. Repair or remove and replace components of built-up roofing system where test results or inspections indicate that they do not comply with specified requirements.

1. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

D. Prepare test and inspection reports.

3.9 DISPOSAL

A. Collect demolished materials and place in containers. Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.

1. Storage or sale of demolished items or materials on-site is not permitted.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

B. Transport and legally dispose of demolished materials off Owner's property.

END OF SECTION 070150

SECTION 071326 - SELF-ADHERING SHEET WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Self-adhering sheet waterproofing for below-grade applications [WP-1].
2. Molded-sheet drainage panels.

B. Related Requirements:

1. Section 033000 "Cast-In-Place Concrete" for concrete substrates to receive self-adhering waterproofing.
2. Sections 071413 "Hot Fluid-Applied Rubberized Asphalt Waterproofing" and 071416 "Cold Fluid-Applied Waterproofing" for source limitation coordination with this Section.

1.3 COORDINATION

A. Coordination installation of molded sheet drainage panels with foundation drainage system and backfill installation.

B. Coordinate compatibility and tie-in to other waterproofing systems where those tie-ins occur.

1. The below-grade self-adhering sheet waterproofing system at the foundation shall continue to grade and shall transition and integrate into the above-grade waterproofing system as specified in Section 071416 "Cold Fluid-Applied Waterproofing."

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Construction Manager, Architect, envelope consultant, inspection agency, self-adhering sheet waterproofing installer, self-adhering sheet waterproofing technical manufacturer's representative, and installers whose work interfaces with or affects self-adhering sheet waterproofing, including installers of adjacent construction that penetrates waterproofing system.
2. Review waterproofing requirements including, but not limited to, the following:

a. Surface preparation.
b. Substrate condition and pretreatment.
c. Minimum curing period.
d. Forecasted weather conditions.
e. Special details and sheet flashings.
f. Installation procedures.
g. Testing and inspection procedures.
h. Protection and repairs.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.

B. Sustainable Design Submittals:

1. Documentation for primers, indicating emissions are within specified limits.

C. Shop Drawings:

1. Provide project-specific shop drawings showing locations and extent of waterproofing.
2. Include details of substrate joints and cracks, expansion joints, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

D. Samples:

1. Self-Adhering Sheet Waterproofing: 8 inches square.
2. Drainage Panels: 4 inches square.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Certification in the form of a letter, on the self-adhering sheet waterproofing manufacturer's letterhead and signed by a technical representative of the manufacturer, confirming the following:

1. Acceptance of substrate.
2. Acceptance of any adjacent waterproofing and/or air/weather barrier system(s), that such systems and interface details are compatible, and will not void warranties.

C. Field quality-control reports.

D. Sample Warranties: For special warranties.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 20 years' experience regularly engaged in the production and sales of self-adhering sheet waterproofing that has been used for similar applications with successful results, that meets or exceeds performance requirements indicated, and of documenting this performance by inclusion in test reports. Manufacturer shall have factory-authorized service representatives who are available for consultation, periodic Project-site observations, and on-site assistance.

B. Installer Qualifications: A firm with not less than 10 years' experience installing self-adhering sheet waterproofing similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

C. Mockups: Build mockups to verify selections made under Sample submittals and to set quality standards for installation.

1. Build mockup of installation on typical vertical surface of 100 sq. ft. of wall area.
2. Mock-ups shall be constructed in presence of manufacturer's technical representative.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials and products in labeled packages. Store and handle in compliance with manufacturer's instructions, recommendations and material safety data sheets. Protect from damage from sunlight, weather, excessive temperatures and construction operations. Remove damaged products.

1. Do not double-stack pallets of waterproofing material on the job site. Provide cover on top and all sides, allowing for adequate ventilation.
2. Store drainage composite or protection board flat and off the ground. Provide cover on top and all sides.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended in writing by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.

1. Do not apply waterproofing in snow, rain, fog, or mist.

B. Maintain adequate ventilation during preparation and application of waterproofing materials.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard or customized warranty, in which manufacturer and installer agree to repair or replace components of waterproofing system that do not comply with requirements or that fail to remain watertight within specified warranty period.

1. Warranty includes removing and reinstalling cladding components, flashings, accessories, substrates, and overburdens.
2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Below-Grade Waterproofing System: Obtain self-adhering sheet waterproofing materials and accessories (including molded-sheet drainage panels) provided under this Section, in conjunction with waterproofing materials provided under Sections 071413 "Hot Fluid-Applied Rubberized Asphalt Waterproofing" and 071416 "Cold Fluid-Applied Waterproofing," from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Provide a complete waterproofing system that prevents the passage of water, including all applicable sealants, transitions, joints, termination assemblies, and accessories whether indicated or not.

2.3 SELF-ADHERING SHEET WATERPROOFING (BELOW GRADE) [WP-1]

A. Composite Sheet Waterproofing: Minimum 60-mil nominal thickness, self-adhering composite sheet consisting of 40 mils of HDPE special-weave saturated with a fluid LDPE laminated to a 20-mils of high-performance butyl, polyethylene-film reinforcement, and with release liner on adhesive side.

1. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

a. Tremco, Inc., "TREMproof 560."

2. Physical Properties:

a. Type: 20-mil high-performance butyl laminated to 40 mils of HDPE special-weave fabric.
b. Color: Black.
c. Solids: 100 percent.
d. Weight: 0.30 lbs sq ft.
e. Puncture Resistance: Exceeds 500 lb.
f. Hydrostatic Resistance: 685 psi.
g. Application Temperature; Temperatures above 20°F.

2.4 MOLDED-SHEET DRAINAGE PANELS

A. Drainage/Protection Board: A two-part prefabricated drainage material and protection board consisting of a formed polystyrene core covered on one side with a woven polypropylene filter fabric. The fabric allows water to pass into the drainage core while restricting the movement of soil particles. The plastic core provides compressive strength and allows high capacity flow. Where indicated, coordinate with Division 22 Section(s) for connection of drainage board to plumbing drain.

1. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

a. Vertical Surfaces: Tremco International; TREMDrain 1000.
b. Horizontal Surfaces: Tremco International; TREMDrain 2000.
c. Water Collection: Tremco International; TREMDrain Total Drain.

2.5 AUXILIARY MATERIALS

A. General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.

B. Primer: Liquid waterborne primer recommended for substrate by sheet-waterproofing material manufacturer.

1. Primer shall have a maximum VOC content of 100g/L.

C. Joint Sealant: Elastomeric, single-component, silicone sealant, ASTM C 920 - Class 50, Type S, Grade NS, Use NT, M, A, O, G.

D. Termination Mastic: Air barrier manufacturer’s standard cold fluid-applied elastomeric liquid; trowel grade, with recommended glass-fiber mesh tape.

E. Termination Bar: Formed-stainless-steel bars with upper flange to receive sealant.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of waterproofing.

1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for moisture by method recommended by manufacturer.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.

E. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.

F. Bridge and cover isolation joints, expansion joints, and discontinuous deck-to-wall and deck-to-deck joints with overlapping sheet strips of widths according to manufacturer's written instructions.

G. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.

H. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing according to ASTM D 6135.

3.3 SELF-ADHERING SHEET-WATERPROOFING APPLICATION

A. Install waterproofing sheets according to waterproofing manufacturer's written instructions and recommendations in ASTM D 6135.

B. When required per manufacturer’s written instructions, apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.

C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch- minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure watertight installation.

1. Firmly roll field, edges, seams, and overlaps of self-adhering sheet waterproofing to substrate below to ensure full adhesion and no blistering.

D. Horizontal Application: Apply sheets from low to high points of decks to ensure that laps shed water.

E. Apply continuous sheets over already-installed sheet strips, bridging substrate cracks, construction, and contraction joints.

F. Seal edges of sheet-waterproofing terminations per manufacturer’s written instructions.

G. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending 6 inches beyond repaired areas in all directions.

H. For below grade applications, immediately install protection course with butted joints over waterproofing membrane.

1. Molded-sheet drainage panels may be used in place of a separate protection course to vertical applications when approved by waterproofing manufacturer and installed immediately.

3.4 MOLDED-SHEET DRAINAGE PANEL INSTALLATION

A. Place and secure molded-sheet drainage panels according to manufacturer's written instructions. Use adhesives or another method that does not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

B. Molded-Sheet Collector-Panel System: Install according to manufacturer's written instructions. Connect to piped subdrainage system specified in Section 334600 "Subdrainage."

3.5 FIELD QUALITY CONTROL (BY CONTRACTOR)

A. Manufacturer’s Field Service: Contractor shall engage a manufacturer’s technical representative for technical assistance and guidance for preparation and application of self-adhering waterproofing. At a minimum, arrange for manufacturer’s technical representative to observe installation of system during mock-ups, initial installation, at mid-point of the installation, and at completion. Provide additional field observation as required to obtain specified warranty and when requested by Architect or Owner. After each visit, submit manufacturer’s written report of observations within 3 business days. The report shall note overall quality of work, deficiencies, and any other concerns, and recommend corrective action.

B. Final Inspection: Arrange for manufacturer’s technical personnel to inspect self-adhering sheet waterproofing upon completion of application.

C. If test results or inspections show self-adhering sheet waterproofing does not comply with requirements, remove and replace or repair the self-adhering sheet waterproofing system as recommended in writing by the manufacturer, and make further repairs after retesting and inspecting until system installation passes. Repair damage to self-adhering sheet waterproofing caused by testing; follow manufacturer's written instructions.

D. Prepare test and inspection reports.

3.6 PROTECTION, REPAIR, AND CLEANING

A. Protect waterproofing from damage and wear during remainder of construction period.

B. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

C. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION 071326

SECTION 071413 - HOT FLUID-APPLIED RUBBERIZED ASPHALT WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Rubberized-asphalt waterproofing membrane, reinforced [WP-2].
2. Molded-sheet drainage panels.

B. Related Requirements:

1. Section 033000 "Cast-In-Place Concrete" for coordination with concrete surface finishing and curing methods required by hot fluid-applied waterproofing manufacturer.
2. Sections 071326 "Self-Adhering Sheet Waterproofing" and 071416 "Cold Fluid-Applied Waterproofing for source limitation coordination with this Section.
3. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.
4. Section 093013 "Ceramic Tiling" for waterproofing below interior ceramic tile.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Construction Manager, Architect, envelope consultant, inspection agency, hot fluid-applied waterproofing installer, hot fluid-applied waterproofing manufacturer's technical representative, and installers whose work interfaces with or affects hot fluid-applied waterproofing, including installers of adjacent construction that penetrates waterproofing system.
2. Review waterproofing requirements including, but not limited to, the following:

a. Cast-in-place concrete surface finishing and restrictions on using curing compounds.
b. Surface preparation.
c. Substrate condition and pretreatment.
d. Minimum curing period.
e. Forecasted weather conditions.
f. Special details and sheet flashings.
g. Installation procedures.
h. Testing and inspection procedures.
i. Protection and repairs.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.

B. Sustainable Design Submittals: For waterproofing and primers, product data for VOC content.

C. Shop Drawings:

1. Provide project-specific shop drawings showing locations and extent of waterproofing.
2. Include details for substrate joints and cracks, penetrations, inside and outside corners, tie-ins with adjoining waterproofing systems, and other termination conditions.

D. Samples: For drainage panels, 4 by 4 inches.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Certification in the form of a letter, on the hot waterproofing manufacturer's letterhead and signed by a technical representative of the manufacturer, confirming the following:

1. Acceptance of substrate.
2. Acceptance of any adjacent waterproofing and/or air/weather barrier system(s), that such systems and interface details are compatible, and will not void warranties.

C. Inspection Report: Copy of cold fluid-applied waterproofing manufacturer’s inspection of completed waterproofing installation.

D. Research/Evaluation Reports: For single-component polyurethane waterproofing, from ICC-ES or City of Los Angeles research report (COLA-RR).

E. Field quality-control reports.

F. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years’ experience regularly engaged in the production and sales of hot fluid-applied waterproofing that has been used for similar applications with successful results, that meets or exceeds performance requirements indicated, and of documenting this performance by inclusion in test reports. Manufacturer shall have factory-authorized service representatives who are available for consultation, periodic Project-site observations, and on-site assistance. Manufacturer shall also have a valid research/evaluation report for single-component polyurethane waterproofing system indicating compliance with the International Building Code / California Building Code.

B. Installer Qualifications: A firm with not less than 10 years’ experience installing hot fluid-applied waterproofing similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

C. Mockups: Install waterproofing to 100 sq. ft. of horizontal surface to demonstrate surface preparation, crack and joint treatment, corner treatment, thickness, texture, and execution quality.

1. Commence mockup installation in presence of manufacturer's technical representative.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by waterproofing manufacturer.

B. Remove and replace liquid materials that cannot be applied within their stated shelf life.

C. Protect stored materials from direct sunlight.

1.8 FIELD CONDITIONS

A. Weather Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate, or when temperature is below zero deg F.

1. Do not apply waterproofing in snow, rain, fog, or mist.

B. Maintain adequate ventilation during application and curing of waterproofing materials.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard or customized warranty, in which manufacturer and installer agree to repair or replace components of waterproofing system that do not comply with requirements or that fail to remain watertight within specified warranty period.

1. Warranty includes removing and reinstalling drainage panels, flashings, accessories, substrates and overburdens.
2. Warranty is based upon minimum application of waterproofing in thickness as specified below.
3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide hot fluid-applied rubberized asphalt waterproofing by the following:

1. Tremco Incorporated; "TREMproof 6100."

B. Source Limitations: Obtain waterproofing materials and drainage panels provided under this Section and Sections 071326 "Self-Adhering Sheet Waterproofing" and 071416 "Cold Fluid-Applied Waterproofing from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Provide a complete waterproofing system that prevents the passage of water, including all applicable sealants, transitions, joints, termination assemblies, and accessories whether indicated or not.

B. Waterproofing components shall have a maximum VOC content of 250 g/L.

2.3 WATERPROOFING MEMBRANE

A. Hot Fluid-Applied, Rubberized-Asphalt Waterproofing Membrane: Single component; 100 percent solids; hot fluid-applied, rubberized asphalt.

1. Thickness: As required to attain specified warranty, but no less than the following:

a. Applied in two lifts of 90-125 mils each, with reinforcing fabric applied after the first lift, for a total overall nominal thickness of 215 mils.

2. Water Vapor Permeance: 1.7 ng.Pa*s*m^2 maximum; ASTM C836; ASTM E 96 Dry Cup.
3. Toughness: 14.9 J at 77 deg F; CAN/CGSB 37.50-M89; Section 4.4.
4. Adhesion Rating: Pass; CAN/CGSB 37.50-M89; Section 4.6.
5. Water Absorption: 0.007 oz; CAN/CGSB 37.50-M89; Section 4.8.
6. Pinholing: 0; CAN/CGSB 37.50-M89; Section 4.9.
7. Low Temperature Flexibility: Pass; CAN/CGSB 37.50-M89; Section 4.10.
8. Low Temperature Crack Bridging: Pass; CAN/CGSB 37.50-M89; Section 4.11.

2.4 MOLDED-SHEET DRAINAGE PANELS

A. Drainage/Protection Board: A two-part prefabricated drainage material and protection board consisting of a formed polystyrene core covered on one side with a woven polypropylene filter fabric. The fabric allows water to pass into the drainage core while restricting the movement of soil particles. The plastic core provides compressive strength and allows high capacity flow. Where indicated, coordinate with Division 22 Section(s) for connection of drainage board to plumbing drain.

1. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

a. Horizontal Surfaces: Tremco International; TREMDrain 2000.

2.5 AUXILIARY MATERIALS

A. General: Auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with waterproofing.

B. Primer: ASTM D 41, asphaltic primer.

C. Elastomeric Sheet: 50-mil-minimum, uncured sheet neoprene with manufacturer's recommended contact adhesives as follows:

1. Tensile Strength: 1400 psi minimum; ASTM D 412, Die C.
2. Elongation: 300 percent minimum; ASTM D 412.
3. Tear Resistance: 125 psi minimum; ASTM D 624, Die C.
4. Brittleness: Does not break at minus 30 deg F; ASTM D 2137.

D. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel termination bars; approximately 1 by 1/8 inch thick; with stainless-steel anchors.

E. Sealants and Accessories: Manufacturer's recommended sealants and accessories.

F. Reinforcing Fabric: Manufacturer's recommended, spun-bonded polyester fabric.

G. Other Accessories: Provide other materials, not specifically described, but required for a complete and proper installation, as selected by the Contractor and approve by the membrane system manufacturer as compatible, subject to review of the Architect.

H. Membrane Leak-Detection System: Conductor cable, placed on top of membrane, delivering direct current tension to membrane surface, enabling inspection and isolation of points of moisture infiltration through membrane to conductive substrate under membrane.

1. Measurement Grid: Highly conductive stainless steel wire measurement grid located under membrane and above non-conductive membrane substrate, connected through contact plate and cable to connection box accepting low-voltage charge from portable pulse generator. Include conductor cable, measurement grid, connection box, and accessories for a complete membrane leak-detection system.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that concrete has cured and aged for minimum time period recommended by waterproofing manufacturer.

2. Verify that substrate is visibly dry and free of moisture.

   a. Moisture Testing: Test for moisture using the methods indicated below or as recommended by hot fluid-applied waterproofing manufacturer.

      1) Anhydrous Calcium Chloride Test: ASTM F 1869.
      2) Internal Relative Humidity Test: Using in situ probes, ASTM F 2170.

   b. Where moisture levels exceed manufacturer's written limitations, implement remedial action(s) recommended by hot fluid-applied waterproofing manufacturer.

3. Engage hot fluid-applied waterproofing manufacturer’s technical representative to inspect substrate conditions prior to application of waterproofing membrane. Obtain manufacturer’s written acceptance of substrate conditions and submit to Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean and prepare substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

C. Close off deck drains and other deck penetrations to prevent spillage and migration of waterproofing fluids.

D. Remove foreign material to provide a sound surface free of all dirt, dust, oil, grease, wax, tar, asphalt, mildew, mold, paint sealers, coatings, curing agents, loose particles, laitance, glaze, efflorescence, concrete hardeners, form-release agents, or any other deleterious material which may interfere with the adhesion of the membrane. Remove remaining loose material and clean surfaces according to ASTM D 4258.

E. Remove fins, ridges, and other projections, and fill honeycomb, aggregate pockets, and other voids.

3.3 JOINTS, CRACKS, AND TERMINATIONS

A. Prepare and treat substrates to receive waterproofing membrane, including joints and cracks, deck drains, corners, and penetrations according to manufacturer's written instructions.

1. Rout and fill joints and cracks in substrate. Before filling, remove dust and dirt according to ASTM D 4258.
2. Adhere strip of elastomeric sheet to substrate in a layer of hot rubberized asphalt. Extend elastomeric sheet a minimum of 6 inches on each side of moving joints and cracks or joints and cracks exceeding 1/8 inch thick, and beyond deck drains and penetrations. Apply second layer of hot fluid-applied, rubberized asphalt over elastomeric sheet.
3. Embed strip of reinforcing fabric into a layer of hot rubberized asphalt. Extend reinforcing fabric a minimum of 6 inches on each side of nonmoving joints and cracks not exceeding 1/8 inch thick, and beyond roof drains and penetrations.

   a. Apply second layer of hot fluid-applied, rubberized asphalt over reinforcing fabric.

B. At expansion joints and discontinuous deck-to-wall or deck-to-deck joints, bridge joints with elastomeric sheet extended a minimum of 6 inches on each side of joints and adhere to substrates in a layer of hot rubberized asphalt. Apply second layer of hot fluid-applied, rubberized asphalt over elastomeric sheet.

3.4 ELECTRONIC LEAK DETECTION GRID INSTALLATION

A. Measurement Grid: Install measurement on membrane substrate immediately under membrane and immediately prior to installation of membrane.

1. Verify that location of measurement grid fasteners does not interfere with or cause damage to membrane.
2. Fasten measurement grid in accordance with leak detection system manufacturer's requirements.
3. Do not place measurement grid where it will be in continuous direct contact with structural components.
4. Provide minimum 2 inch overlap where adjacent sheets meet, including side laps and end laps.
5. Cut measurement grid as close as possible to the perpendicular strand at both end and side edges

B. Conductor Wire: Install conductor wire on top of membrane at spacing and layout indicated on approved shop drawings.

C. Secure conductor wire using method recommended by manufacturer.

3.5 FLASHING INSTALLATION

A. Install elastomeric sheets at terminations of waterproofing membrane according to manufacturer's written instructions.

B. Prime substrate with asphalt primer.

C. Install elastomeric sheet and adhere to deck and wall substrates in a layer of hot rubberized asphalt.

D. Extend elastomeric sheet up walls or parapets a minimum of 8 inches above deck and 6 inches onto deck to be waterproofed.

E. Install termination bars and mechanically fasten to top of elastomeric flashing sheet at terminations and perimeter of waterproofing.

3.6 MEMBRANE APPLICATION

A. Apply primer, at manufacturer's recommended rate, over prepared substrate and allow it to dry.

B. Heat and apply rubberized asphalt according to manufacturer's written instructions.

1. Heat rubberized asphalt in an oil- or air-jacketed melter with mechanical agitator specifically designed for heating rubberized asphalt.

C. Start application with manufacturer's authorized representative present.

D. Reinforced Membrane: Apply hot rubberized asphalt to substrates and adjoining surfaces indicated. Spread to a thickness of 90 to 125 mils; embed reinforcing fabric, overlapping sheets 2 inches; spread another 90 to 125-mil-thick layer to provide a uniform, reinforced, seamless membrane 215 mils thick.

E. Apply waterproofing over prepared joints and up wall terminations and vertical surfaces to heights indicated or required by manufacturer.

F. Cure waterproofing, taking care to prevent contamination and damage during application and curing.

G. Cover waterproofing with protection course with overlapped joints before membrane is subject to construction traffic.

3.7 MOLDED-SHEET DRAINAGE PANEL INSTALLATION

A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate according to manufacturer's written instructions. Use methods that do not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

3.8 FIELD QUALITY CONTROL (BY OWNER)

A. Testing Agency: Owner will engage a qualified testing agency to perform testing and inspections and to prepare test reports.

1. Electronic Leak-Detection Testing: Testing agency shall test each deck area for leaks using electronic leak detection method that locates discontinuities in the membrane.

a. Testing agency shall perform tests on abutting or overlapping smaller areas as necessary to cover entire test area.
b. Testing agency shall create a conductive electronic field over the area of membrane to be tested and electronically determine locations of discontinuities or leaks, if any, in the roofing membrane.
c. Testing agency shall provide survey report indicating locations of discontinuities, if any.

B. If test results or inspections show waterproofing does not comply with requirements, remove and replace or repair the waterproofing as recommended in writing by manufacturer, and make further repairs after retesting and inspecting until waterproofing installation passes.

3.9 FIELD QUALITY CONTROL (BY CONTRACTOR)

A. Manufacturer's Field Service: Contractor shall engage a manufacturer’s technical representative for technical assistance and guidance for preparation and application of cold fluid-applied waterproofing. At a minimum, arrange for manufacturer’s technical representative to observe installation of hot fluid-applied waterproofing system during mock-up, first 100 square feet of initial installation, at mid-point of the installation, and at completion. Provide additional field observation as required to obtain warranty specified and when requested by Architect or Owner. After each field visit, submit manufacturer’s written report of observations within 3 working days. The report shall note overall quality of work, deficiencies, and any other concerns, and recommend corrective action.

1. Site representative shall measure membrane thickness with pin tester or other suitable device at least once for every 100 sq. ft. and include measurements in reports.

B. Final Waterproofing Inspection: Arrange for cold fluid-applied waterproofing manufacturer’s technical personnel to inspect waterproofing installation upon completion of application, and for those areas that remain visible to view, again at time of project’s overall Substantial Completion.

C. If test results or inspections show waterproofing does not comply with requirements, remove and replace or repair the waterproofing as recommended in writing by manufacturer, and make further repairs after retesting and inspecting until waterproofing installation passes.

D. Prepare test and inspection reports.

3.10 CLEANING AND PROTECTION

A. Do not permit construction traffic or backfill on unprotected membrane.

B. Protect waterproofing from damage and wear during remainder of construction period.

C. Protect installed board insulation and drainage panels from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

D. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

E. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 071413

SECTION 071416 - COLD FLUID-APPLIED WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Single-component modified polyurethane waterproofing [WP-3].
2. Composite liquid polyurethane U.V.-stable waterproofing, custom colored [WP-4].
3. Molded-sheet drainage/protection panels.

B. Related Requirements:

1. Section 033000 "Cast-In-Place Concrete" for coordination with concrete surface finishing and curing methods required by cold fluid-applied waterproofing manufacturer.
2. Sections 071326 "Self-Adhering Sheet Waterproofing" and 071413 "Hot Fluid-Applied Rubberized Asphalt Waterproofing" for source limitations coordinated with this Section.
3. Section 079200 “Joint Sealants” for joint-sealants if not provided as part of this Section.
4. Section 093013 "Ceramic Tiling" for waterproofing below interior ceramic tile.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Construction Manager, Architect, envelope consultant, inspection agency, cp;d fluid-applied waterproofing installer, cold fluid-applied waterproofing manufacturer's technical representative, and installers whose work interfaces with or affects cold fluid-applied waterproofing, including installers of adjacent construction that penetrates waterproofing system.
2. Review waterproofing requirements including, but not limited to, the following:

a. Cast--in-place concrete surface finishing and restrictions on using curing compounds.
b. Surface preparation.
c. Substrate condition and pretreatment.
d. Minimum curing period.
e. Forecasted weather conditions.
f. Special details and sheet flashings.
g. Installation procedures.
h. Testing and inspection procedures.
i. Protection and repairs.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.

B. Sustainable Design Submittals: For waterproofing and primers, product data for VOC content.

C. Shop Drawings:

1. Show locations and extent of waterproofing.
2. Include details for substrate joints and cracks, penetrations, inside and outside corners, tie-ins with adjoining waterproofing systems, and other termination conditions.

D. Samples: For each exposed product and for each color and texture specified, including the following products:

1. Color samples for exposed waterproofing, on rigid backing, 8 inches square.
2. Drainage panels, 4 by 4 inches.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Substrate Acceptance: Letter signed and executed by manufacturer's technical representative indicating manufacturer's acceptance of substrate prior to application of cold fluid-applied waterproofing.

C. Inspection Report: Copy of cold fluid-applied waterproofing manufacturer's inspection of completed waterproofing installation.

D. Research/Evaluation Reports: For single-component polyurethane waterproofing, from ICC-ES or City of Los Angeles research report (COLA-RR).

E. Field quality-control reports.

F. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of cold fluid-applied waterproofing that has been used for similar applications with successful results, that meets or exceeds performance requirements indicated, and of documenting this performance by inclusion in test reports. Manufacturer shall have factory-authorized service representatives who are available for consultation, periodic Project-site observations, and on-site assistance. Manufacturer shall also have a valid research/evaluation report for single-component polyurethane waterproofing system indicating compliance with the International Building Code / California Building Code.

B. Installer Qualifications: A firm with not less than 10 years' experience installing cold fluid-applied waterproofing similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

C. Mockups: Build mockups to verify selections made under Sample submittals and to set quality standards for installation.

1. Build mockup for each typical waterproofing installation including accessories to demonstrate surface preparation, crack and joint treatments, inside and outside corner treatments, color, and protection.

    a. Commence mockup installation in presence of manufacturer's technical representative.
    b. Description: First 100 square feet of installation.
    c. Bond Test: Determine the compatibility of the cold fluid-applied waterproofing to the concrete by a bond test in accordance with the cold fluid-applied waterproofing manufacturer's recommendations. Submit copy of test reports to Owner and Architect.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by waterproofing manufacturer.

B. Remove and replace liquid materials that cannot be applied within their stated shelf life.

C. Protect stored materials from direct sunlight.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended in writing by waterproofing manufacturer.

1. Do not apply waterproofing to a damp or wet substrate, when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F above dew point.
2. Do not apply waterproofing in snow, rain, fog or mist, or when such weather conditions are imminent during application and curing period.

B. Maintain adequate ventilation during application and curing of waterproofing materials.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard or customized warranty, in which manufacturer and installer agree to repair or replace components of waterproofing system that do not comply with requirements or that fail to remain watertight within specified warranty period.

1. Warranty includes removing and reinstalling drainage panels, flashings, accessories, substrates and overburdens.
2. Warranty is based upon minimum application of waterproofing in thickness as specified below.
3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide cold fluid-applied waterproofing products by the following:

1. Tremco Incorporated. See below for specific products.

B. Source Limitations: Obtain waterproofing materials and drainage panels provided under this Section and Sections 071326 "Self-Adhering Sheet Waterproofing" and 071413 "Hot Fluid-Applied Rubberized Asphalt Waterproofing from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Provide a complete waterproofing system that prevents the passage of water, including all applicable sealants, transitions, joints, termination assemblies, and accessories whether indicated or not.

B. Single-component, reinforced, modified polyurethane waterproofing system shall be compatible with composite liquid polyurethane U.V.-stable waterproofing, so as to allow the U.V.-stable waterproofing system to flash with the primary waterproofing system as part of an overall system warranty.

C. Waterproofing components shall have a maximum VOC content of 250 g/L.

2.3 SINGLE-COMPONENT POLYURETHANE WATERPROOFING [WP-3]

A. Single-Component, Modified Polyurethane Waterproofing: ASTM C 836.

1. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

a. Tremco Incorporated; TREMproof 250GC.

2. Thickness: As required to attain specified warranty, and no less than 120 wet mils.
3. Solids Content: Minimum 80 percent in accordance with ASTM C 1250.
4. Substrate Conditions: Suitable for application over green concrete.
5. Compatible with composite liquid polyurethane U.V.-stable waterproofing as transition flashing.

2.4 COMPOSITE LIQUID POLYURETHANE U.V.-STABLE WATERPROOFING [WP-4]

A. Composite Liquid Polyurethane U.V.-Stable Waterproofing: Comply with ASTM C 957 and manufacturer's written requirements.

1. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

a. Tremco Incorporated; Vulkem 350NF base coat and 951NF intermediate and top coats.

2. Base Coat Thickness: As recommended in writing by manufacturer for substrate and service conditions indicated, and as required to attain warranty duration indicated, but no less than 40 mils.
3. Intermediate Coat Thickness: As recommended in writing by manufacturer for substrate and service conditions indicated, and as required to attain warranty duration indicated, but no less than 12 mils.
4. Top Coat Thickness: As recommended in writing by manufacturer for substrate and service conditions indicated, and as required to attain warranty duration indicated, but no less than 12 mils.
5. Solids Content: Minimum 90 percent in accordance with ASTM C 792.
6. Compatible as flashing for single-component, reinforced, modified polyurethane waterproofing.
7. Custom Color: Match Architect's sample.

2.5 MOLDED-SHEET DRAINAGE PANELS

A. Drainage/Protection Board: A two-part prefabricated drainage material and protection board consisting of a formed polystyrene core covered on one side with a woven polypropylene filter fabric. The fabric allows water to pass into the drainage core while restricting the movement of soil particles. The plastic core provides compressive strength and allows high capacity flow. Where indicated, coordinate with Division 22 Section(s) for connection of drainage board to plumbing drain.

1. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

a. Vertical Surfaces: Tremco International; TREMDrain 1000.
b. Horizontal Surfaces: Tremco International; TREMDrain 2000.
c. Water Collection: Tremco International; TREMDrain Total Drain.

2.6 AUXILIARY MATERIALS

A. General: Provide auxiliary materials recommended in writing by waterproofing manufacturer for intended use and compatible with one another and with waterproofing.

B. Primer: Manufacturer's standard factory-formulated polyurethane or epoxy primer.

C. Joint Reinforcing Strip: Manufacturer's recommended fiberglass mesh or polyester fabric.

D. Joint Sealant: As specified in Section 079200 "Joint Sealants" and as recommended by manufacturer for substrate and joint conditions.

1. Backer Rod: Open-cell polyethylene foam.

E. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

F. Other Accessories: Provide other materials, not specifically described, but required for a complete and proper installation, as selected by the Contractor and approve by the membrane system manufacturer as compatible, subject to review of the Architect.

G. Membrane Leak-Detection System: Conductor cable, placed on top of membrane, delivering direct current tension to membrane surface, enabling inspection and isolation of points of moisture infiltration through membrane to conductive substrate under membrane.

1. Measurement Grid: Highly conductive stainless steel wire measurement grid located under membrane and above non-conductive membrane substrate, connected through contact plate and cable to connection box accepting low-voltage charge from portable pulse generator. Include conductor cable, measurement grid, connection box, and accessories for a complete membrane leak-detection system.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
2. Verify that substrate is visibly dry and free of moisture.

a. Moisture Testing: Test for moisture using the methods indicated below or as recommended by cold fluid-applied waterproofing manufacturer.

1) Anhydrous Calcium Chloride Test: ASTM F 1869.
2) Internal Relative Humidity Test: Using in situ probes, ASTM F 2170.

b. Where moisture levels exceed manufacturer's written limitations, implement remedial action(s) recommended by cold fluid-applied waterproofing manufacturer.

3. Engage cold fluid-applied waterproofing manufacturer’s technical representative to inspect substrate conditions prior to application of waterproofing membrane. Obtain manufacturer’s written acceptance of substrate conditions and submit to Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

C. Close off deck drains and other deck penetrations to prevent spillage and migration of waterproofing fluids.

D. Remove foreign material to provide a sound surface free of all dirt, dust, oil, grease, wax, tar, asphalt, mildew, mold, paint sealers, coatings, curing agents, loose particles, laitance, glaze, efflorescence, concrete hardeners, form-release agents, or any other deleterious material which may interfere with the adhesion of the membrane. Remove remaining loose material and clean surfaces according to ASTM D 4258.

E. Remove fins, ridges, and other projections, and fill honeycomb, aggregate pockets, holes, and other voids.

3.3 PREPARATION AT TERMINATIONS, PENETRATIONS, AND CORNERS

A. Prepare surfaces at terminations and penetrations through waterproofing and at expansion joints, sleeves, and corners according to waterproofing manufacturer's written instructions and to recommendations in ASTM C 898 and ASTM C 1471.

B. Prime substrate, unless otherwise instructed by waterproofing manufacturer.

C. Apply waterproofing in two separate applications, and embed a joint reinforcing strip in the first preparation coat when recommended by waterproofing manufacturer.

1. Provide sealant cants around penetrations and at inside corners of deck-to-wall butt joints when recommended by waterproofing manufacturer.

3.4 JOINT AND CRACK TREATMENT

A. Prepare, treat, rout, and fill joints and cracks in substrate according to waterproofing manufacturer's written instructions and to recommendations in ASTM C 898 and ASTM C 1471. Before coating surfaces, remove dust and dirt from joints and cracks according to ASTM D 4258.

1. Comply with ASTM C 1193 for joint-sealant installation.
2. Apply bond breaker on sealant surface, beneath preparation strip.
3. Prime substrate along each side of joint and apply a single thickness of preparation strip at least 6 inches wide along each side of joint. Apply waterproofing in two separate applications and embed a joint reinforcing strip in the first preparation coat.

3.5 ELECTRONIC LEAK DETECTION GRID INSTALLATION

A. Measurement Grid: Install measurement on membrane substrate immediately under membrane and immediately prior to installation of membrane.

1. Verify that location of measurement grid fasteners does not interfere with or cause damage to membrane.
2. Fasten measurement grid in accordance with leak detection system manufacturer's requirements.
3. Do not place measurement grid where it will be in continuous direct contact with structural components.
4. Provide minimum 2 inch overlap where adjacent sheets meet, including side laps and end laps.
5. Cut measurement grid as close as possible to the perpendicular strand at both end and side edges

B. Conductor Wire: Install conductor wire on top of membrane at spacing and layout indicated on approved shop drawings.

C. Secure conductor wire using method recommended by manufacturer.

3.6 WATERPROOFING APPLICATION

A. Apply waterproofing according to manufacturer's written instructions and to recommendations in ASTM C 898 and ASTM C 1471.

B. Start installing waterproofing in presence of manufacturer's technical representative.

C. Apply primer over prepared substrate unless otherwise instructed in writing by waterproofing manufacturer.

D. Unreinforced Waterproofing Applications: Mix materials and apply waterproofing by spray, roller, notched squeegee, trowel, or other application method suitable to slope of substrate.

1. Apply first coat of waterproofing and cure per manufacturer’s written instructions. Apply second coat of waterproofing to obtain a seamless membrane free of entrapped gases. Provide in thickness specified in “Single Component Polyurethane Waterproofing” Article above.
2. Apply waterproofing to prepared wall terminations and vertical surfaces.
3. Verify manufacturer's recommended wet film thickness of waterproofing every 100 sq. ft..

E. Cure waterproofing, taking care to prevent contamination and damage during application and curing.

3.7 MOLDED-SHEET DRAINAGE PANEL INSTALLATION

A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, according to manufacturer's written instructions. Use adhesive or another method that does not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.

B. Molded-Sheet Collector-Panel System: Install according to manufacturer's written instructions.

3.8 FIELD QUALITY CONTROL (BY OWNER)

A. Testing Agency: Owner will engage a qualified testing agency to perform testing and inspections and to prepare test reports.

1. Electronic Leak-Detection Testing: Testing agency shall test each deck area for leaks using electronic leak detection method that locates discontinuities in the membrane.

a. Testing agency shall perform tests on abutting or overlapping smaller areas as necessary to cover entire test area.
b. Testing agency shall create a conductive electronic field over the area of membrane to be tested and electronically determine locations of discontinuities or leaks, if any, in the roofing membrane.
c. Testing agency shall provide survey report indicating locations of discontinuities, if any.

B. If test results or inspections show waterproofing does not comply with requirements, remove and replace or repair the waterproofing as recommended in writing by manufacturer, and make further repairs after retesting and inspecting until waterproofing installation passes.

3.9 FIELD QUALITY CONTROL (BY CONTRACTOR)

A. Manufacturer's Field Service: Contractor shall engage a manufacturer’s technical representative for technical assistance and guidance for preparation and application of cold fluid-applied waterproofing. At a minimum, arrange for manufacturer’s technical representative to observe installation of cold fluid-applied waterproofing system during mock-up (first 100 square feet of initial installation), at mid-point of the installation, and at completion. Provide additional field observation as required to obtain warranty specified and when requested by Architect or Owner. After each field visit, submit manufacturer’s written report of observations within 3 working days. The report shall note overall quality of work, deficiencies, and any other concerns, and recommend corrective action.

B. Final Waterproofing Inspection: Arrange for cold fluid-applied waterproofing manufacturer’s technical personnel to inspect waterproofing installation upon completion of application, and for those areas that remain visible to view, again at time of project’s overall Substantial Completion.

C. If test results or inspections show waterproofing does not comply with requirements, remove and replace or repair the waterproofing as recommended in writing by manufacturer, and make further repairs after retesting and inspecting until waterproofing installation passes.

D. Prepare test and inspection reports.

3.10 CLEANING AND PROTECTION

A. Do not permit traffic or backfill on unprotected membrane.

B. Protect waterproofing from damage and wear during remainder of construction period.

C. Protect installed drainage panels from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

D. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

E. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION 071416

SECTION 071616 - CRYSTALLINE WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes crystalline waterproofing system [WP-5].

1. Crystalline admixture (batch mix) and crystalline cementitious slurry coats for the following concrete surfaces:

a. At elevator pits, including walls, slab, and sump pits.
b. Where indicated.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for admixture for integral crystalline waterproofing and the finishing of concrete walls and slabs to receive waterproofing.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, and installation instructions.

B. Sustainable Design Submittals: For fluid-applied products, product data for VOC content.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and applicator.

B. Product Certificates: For each type of waterproofing, patching, and plugging material.

C. Product Test Reports: For each product formulation, for tests performed by manufacturer and witnessed by a qualified testing agency.

D. Batch tickets from concrete plant, confirming inclusion of crystalline waterproofing admixture into concrete mix.

E. Field quality-control reports.

F. Warranty: Sample of special warranty.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of crystalline waterproofing that has been used for similar applications with successful results, that meets or exceeds performance requirements indicated, and of documenting this performance by inclusion in test reports. Manufacturer shall have factory-authorized service representatives who are available for consultation, periodic Project-site observations, and on-site assistance.

B. Applicator Qualifications: A firm with not less than 10 years' experience installing crystalline waterproofing similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

1.7 FIELD CONDITIONS

A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit crystalline waterproofing to be performed according to manufacturer's written instructions.

B. Proceed with waterproofing work only after pipe sleeves, vents, curbs, inserts, drains, and other projections through the substrate to be waterproofed have been completed. Proceed only after substrate defects, including honeycombs, voids, and cracks, have been repaired to provide a sound substrate free of forming materials, including reveal inserts.

C. Ambient Conditions: Proceed with waterproofing work only if temperature is maintained at 40 deg F or above during work and cure period, and space is well ventilated and kept free of water.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard or customized warranty, in which manufacturer and installer agree to repair or replace components of crystalline waterproofing that fail in materials or workmanship within specified warranty period.

1. Failures, include, but are not limited to, the following:

a. Failure to maintain watertight conditions within specified warranty period.

2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide crystalline waterproofing products by the following:

1. Xypex Chemical Corporation. See below for specific products.

B. Source Limitations: Provide crystalline waterproofing products from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Provide a complete waterproofing system that prevents the passage of water in elevator pits and where indicated.

B. Waterproofing components shall have a maximum VOC content of 250 g/L.

2.3 CRYSTALLINE WATERPROOFING SYSTEM [WP-5]

A. Crystalline Waterproofing Admixture: Proprietary crystalline waterproofing admixture, when included in the concrete mix at the time of batching, reacts chemically with the byproducts of cement hydration in the presence of water to develop crystalline growth within substrate capillaries to produce an impervious, dense, waterproof substrate; that has VOC content complying with limits of authorities having jurisdiction; with properties meeting or exceeding the criteria specified below.

1. Basis-of-Design Products: Subject to compliance with requirements, provide the following:

a. Xypex Chemical Corporation; Xypex Admix.
b. Or Comparable Equal.

2. Water Permeability: Maximum zero for water at 30 feet when tested according to CE CRD-C 48.
3. Compressive Strength: Refer to minimum compressive strength requirements on Structural Drawings when tested according to ASTM C 109.

B. Crystaline Waterproofing Slurry Coat: Factory-premixed cementitious slurry coat applied to above-grade or below-grade concrete. Also mixed in dry-pac form for sealing strips at construction joints, or for the repair of cracks, construction joints, or for the repair of cracks; compatible with substrate and other materials indicated; and VOC content complying with limits of authorities having jurisdiction.

1. Basis-of-Design Product:

a. Xypex Chemical Corporation; Xypex Concentrate.
b. Or Comparable Equal.

2.4 ACCESSORY MATERIALS

A. Portland Cement: ASTM C 150, Type I.

B. Sand: ASTM C 144.

C. Water: Potable.

2.5 MIXES

A. Crystalline Waterproofing: Add prepackaged dry ingredients to water according to manufacturer's written instructions. Mix together with mechanical mixer or by hand to required consistency.

B. Crystalline Waterproofing Slurry Coat: Measure, batch, and mix Portland cement and sand according to manufacturer’s written instructions. Blend together with mechanical mixer to required consistency.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for suitable conditions where waterproofing is to be applied.

B. Proceed with application only after unsatisfactory conditions have been corrected.

C. Notify Architect in writing of active leaks or defects that would affect system performance.

3.2 PREPARATION

A. Comply with manufacturer's written instructions.

B. Protect other work from damage caused by cleaning, preparation, and application of waterproofing. Provide temporary enclosure to confine spraying operation and to ensure adequate ambient temperatures and ventilation conditions for application.

C. Do not allow waterproofing, patching, and plugging materials to enter reveals or annular spaces intended for resilient sealants or gaskets, such as joint spaces between pipes and pipe sleeves.

D. Stop active water leaks with plugging compound.

E. Repair damaged or unsatisfactory substrate with patching compound.

1. At holes and cracks 1/16 inch wide or larger in substrate, remove loosened chips and cut reveal with sides perpendicular to surface, not tapered, and minimum 1 inch deep. Fill reveal with patching compound flush with surface.

F. Surface Preparation: Remove efflorescence, chalk, dust, dirt, mortar spatter, grease, oils, paint, curing compounds, and form-release agents to ensure that waterproofing bonds to surfaces.

1. Clean concrete surfaces according to ASTM D 4258.

a. Scratch- and Float-Finished Concrete: Etch with 10 percent muriatic acid solution according to ASTM D 4260.
b. Smooth-Formed and Trowel-Finished Concrete: Prepare by mechanical abrading or abrasive-blast cleaning according to ASTM D 4259.

2. Concrete Joints: Clean reveals.

3.3 APPLICATION

A. General: Comply with waterproofing manufacturer's written instructions for application and curing.

B. Admixture Application: Include crystalline waterproofing admixture to the concrete mix at the time of batching. Thoroughly blend admixture throughout the concrete mix. Comply with manufacturer’s written instructions.

1. Include in all cast-in-place concrete forming elevator hoistway (walls, slabs, sump pit, etc.) and where indicated.

C. Slurry Coat Application: Apply crystalline waterproofing to joint surfaces between concrete pours. Moisten surfaces prior to slurry application. Where joint surfaces are not accessible prior to pouring new concrete, consult manufacturer for application procedure.

1. Include on hoistway side of all cast-in-place concrete forming elevator hoistway (walls, slabs, sump pit, etc.) and where indicated.

D. Curing: Moist-cure waterproofing for three days immediately after final coat has set, followed by air drying, unless otherwise recommended in writing by manufacturer.

E. Waterproofing Treatment Extensions: Extend waterproofing treatment as follows:

1. Onto every substrate in areas indicated for treatment, including pipe trenches, pipe chases, pits sumps, and similar offsets and features.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed application of waterproofing.

B. Prepare test and inspection reports.

END OF SECTION 071616

SECTION 071900 - WATER REPELLENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes penetrating water-repellent treatments for the following exposed vertical and horizontal surfaces:

1. Concrete unit masonry.

B. Related Requirements:

1. Section 042200 "Concrete Unit Masonry" for concrete unit masonry assemblies to receive water repellents.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's printed statement of VOC content.
2. Include manufacturer's recommended number of coats for each type of substrate and spreading rate for each separate coat.

B. Samples: For each type of water repellent and substrate indicated, 12 by 12 inches in size, with specified water-repellent treatment applied to half of each Sample.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and applicator.

B. Product Certificates: For each type of water repellent.

C. Preconstruction Test Reports: For water-repellent-treated substrates.

D. Field quality-control reports.

E. Sample Warranty: For special warranty.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of water repellents that have been used for similar applications with successful results, that meets or exceeds performance requirements indicated, and of documenting this performance by inclusion in test reports. Manufacturer shall have factory-authorized service representatives who are available for consultation, periodic Project-site observations, and on-site assistance.

B. Applicator Qualifications: A firm with not less than 5 years' experience applying water repellents similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

C. Mockups: Prepare mockups of each required water repellent on each type of substrate required to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Coordinate application of water repellent mockup with sample panels specified in Section 042200 "Concrete Unit Masonry."
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.7 FIELD CONDITIONS

A. Limitations: Proceed with application only when the following existing and forecasted weather and substrate conditions permit water repellents to be applied according to manufacturers' written instructions and warranty requirements:

1. Concrete surfaces and mortar have cured for not less than 28 days.
2. Building has been closed in for not less than 30 days before treating wall assemblies.
3. Ambient temperature is above 40 deg F and below 100 deg F and will remain so for 24 hours.
4. Substrate surface temperature is above 40 deg F and below 100 deg F.
5. Rain is not predicted within 24 hours.
6. Not less than seven days have passed since surfaces were last wet.
7. Windy conditions do not exist that might cause water repellent to be blown onto vegetation or surfaces not intended to be treated.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard or customized warranty in which manufacturer and installer agree to repair or replace materials that fail to maintain water repellency specified in "Performance Requirements" Article within specified warranty period.

1. Warranty Period: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Performance: Water repellents shall meet the following performance requirements as determined by testing on manufacturer's standard substrates representing those indicated for this Project.

B. Water Absorption: Minimum 89 percent reduction of water absorption after 24 hours for treated compared to untreated specimens when tested according to ASTM C 97.

C. Water-Vapor Transmission: Maximum 10 percent reduction water-vapor transmission of treated compared to untreated specimens, according to ASTM E 96.

D. Surface Deterioration / Discoloration: None.

E. Surface Appearance After Application: No change; no staining.

2.2 PENETRATING WATER REPELLENTS

A. Siloxane Penetrating Water Repellent: Clear, non-staining, breathable, water-based siloxane water repellent for CMU substrates; with a maximum VOC content of 100 g/L.

1. Basis-of-Design Product: Subject to compliance with requirements, and approval of mock-up, provide the following:

a. PROSOCO, Inc.; Siloxane WB Concentrate.
b. Or comparable equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements and conditions affecting performance of the Work.

1. Verify that surfaces are clean and dry according to water-repellent manufacturer's requirements. Check moisture content in three representative locations by method recommended by manufacturer.
2. Inspect for previously applied treatments that may inhibit penetration or performance of water repellents.
3. Verify that there is no efflorescence or other removable residues that would be trapped beneath the application of water repellent.
4. Verify that required repairs are complete, cured, and dry before applying water repellent.

B. Test pH level according to water-repellent manufacturer's written instructions to ensure chemical bond to silica-containing or siliceous minerals.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. New Construction and Repairs: Allow concrete and other cementitious materials to age before application of water repellent, according to repellent manufacturer's written instructions.

B. Cleaning: Before application of water repellent, clean substrate of substances that could impair penetration or performance of product according to water-repellent manufacturer's written instructions and as follows:

1. Cast-in-Place Concrete and Concrete Unit Masonry: Remove oil, curing compounds, laitance, and other substances that inhibit penetration or performance of water repellents according to ASTM E 1857.

C. Protect adjoining work, including mortar and sealant bond surfaces, from spillage or blow-over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces. Cover live vegetation.

D. Coordination with Mortar Joints: Do not apply water repellent until pointing mortar for joints adjacent to surfaces receiving water-repellent treatment has been installed and cured.

E. Coordination with Sealant Joints: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.

1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those required.

3.3 APPLICATION

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect the substrate before application of water repellent and to instruct Applicator on the product and application method to be used.

B. Apply a heavy-saturation coating of water repellent, on surfaces indicated for treatment, to the point of saturation. Apply coating in dual passes of uniform, overlapping strokes. Remove excess material; do not allow material to puddle beyond saturation. Comply with manufacturer's written instructions for application procedure unless otherwise indicated.

C. Apply a second saturation coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.

3.4 FIELD QUALITY CONTROL

A. Testing of Water-Repellent Material: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when water repellent is being applied:

1. Owner will engage the services of a qualified testing agency to sample water-repellent material being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
2. Testing agency will perform tests for compliance of water-repellent material with product requirements.
3. Owner may direct Contractor to stop applying water repellents if test results show material being used does not comply with product requirements. Contractor shall remove noncomplying material from Project site, pay for testing, and correct deficiency of surfaces treated with rejected materials, as approved by Architect.

B. Coverage Test: In the presence of Architect, hose down a dry, repellent-treated surface to verify complete and uniform product application. A change in surface color will indicate incomplete application.

1. Notify Architect seven days in advance of the dates and times when surfaces will be tested.
2. Reapply water repellent until coverage test indicates complete coverage.

3.5 CLEANING

A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Correct damage to work of other trades caused by water-repellent application, as approved by Architect.

B. Comply with manufacturer's written cleaning instructions.

END OF SECTION 071900

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Perimeter fire containment insulation system.
2. Extruded polystyrene foam-plastic board insulation [I-1]:

    a. At exterior plaza decks over conditioned spaces only, excluding roofs and vegetated roofs.

3. Mineral-wool board insulation [I-2]:

    a. Continuous insulation in exterior walls.

4. Glass-fiber blanket insulation, noncombustible only [I-3]:

    a. Between studs / joists in exterior walls / floors / soffits.

5. This section does not include insulation for:

    a. Roofing insulation.
    b. Vegetated roof (green roof) systems.
    c. Sound attenuation blankets for interior partitions.

B. Related Requirements:

1. Section 075419 "Polyvinyl-Chloride (PVC) Roofing" for insulation installed as part of a roofing assembly.
2. Section 077273 "Vegetated Roof Systems" for insulation installed as part of a green roof assembly.
3. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" and Section 092900 “Gypsum Board” for insulation installed in metal-framed gypsum board assemblies.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Sustainable Design Submittals: Product data indicating compliance with sustainable design performance requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of thermal insulation has been used for similar applications with successful results, that meets or exceeds performance requirements indicated, and of documenting this performance by inclusion in test reports. Manufacturer shall have factory-authorized service representatives who are available for consultation, periodic Project-site observations, and on-site assistance.

B. Installer Qualifications: A firm with not less than 5 years' experience installing thermal insulation similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide thermal insulation products by the following:

1. See below for specific manufacturers and products.

B. Source Limitations: Obtain each insulation type/system from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General: Thermal insulation shall comply with the 2016 California Building Code (CBC), 2016 California Energy Code (CEC), and 2016 California Green Building Standards Code (CALGreen) mandatory measures.

B. Fire Propagation Characteristics for Insulation in Exterior Walls: Comply with one of the following:

1. Product shall be noncombustible passing ASTM E 136 for combustion characteristics.
2. Passes NFPA 285 testing as part of an approved assembly. Manufacturer shall have NFPA 285 test data conducted on configurations for exterior wall systems designs exactly matching those proposed for Project.

C. Provide insulation in thicknesses complying with the following:

1. As indicated on the Drawings, in compliance with the Project's ENV forms, and no less than the following:

	New Building	Tenant Improvement	Parking Structure
Walls (metal framed, between studs)	R-11		
Walls (metal framed, between studs, tile only)	R-19		
Walls (metal framed, continuous)	R-8		
Mass walls	R-11		
Spandrel Walls	R-13		
Floors / soffits (continuous)	R-8		
Green Roof (continuous)*	N/A	N/A	N/A
Roof (continuous)**	N/A	N/A	N/A

* As specified in Section 077273 "Vegetated Roof Systems"
** As specified in Section 075419 "Polyvinyl-Chloride (PVC) Roofing"

D. Sustainable Design Requirements: Products shall be GreenGuard certified.

2.3 PERIMETER FIRE CONTAINMENT INSULATION SYSTEM

A. Performance Criteria: Provide fire-resistive joint systems that are produced and installed to resist spread of fire, resist the passage of smoke and other gasses, and maintain original fire-resistance rating of assemblies in or between which fire-resistive joint system is installed. Fire-resistive joint system shall accommodate building movements without impairing their ability to resist the passage of fire and hot gasses. Provide with rating determined by ASTM E 119 based on testing at a positive pressure differential of 0.01-inch wg or ASTM E 2307. At perimeter of edge of fire-resistant-rated floor assemblies and non-fire-rated exterior curtain walls, provide a fire-containment system with fire test response characteristics indicated, as determined by testing identical systems per the Underwriters Laboratories or Intertek (OPL) Laboratories, or another testing and inspecting agency acceptable to authorities having jurisdiction. If no tested system exists, provide an engineering judgment as specified by the International Firestop Council that accompanies the design.

1. Fire-Resistance Rating: In accordance with 2016 CBC 715.5.

B. Curtain Wall (Spandrel) Insulation:

1. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide the following:

a. Roxul, Inc.; "CurtainRock 40."

2. Thickness: Minimum thickness as listed in fire-tested assembly, but not less than thickness required to comply with “Performance Requirements” article above.
3. Type: Mineral Wool.

a. R-Value: Minimum 4.2 per inch.
b. Facing: Foil Faced.
c. Density: 4 lbs per cubic foot according to ASTM C 612.
d. Combustion Characteristics: Noncombustible according to ASTM E 136.

C. Safing Insulation:

1. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide the following:

a. Roxul, Inc.; "Roxul Safe."

2. Type: Mineral Wool Safing.

a. R-Value: Minimum 4.2 per inch.
b. Facing: Unfaced or foil faced, as listed in fire-tested assembly.
c. Density: 4.5 lbs per cubic foot.
d. Combustion Characteristics: Noncombustible according to ASTM E 136.

D. Safing Clips: Z-Shaped galvanized steel clips formed from 1 inch wide strips of 20-gauge galvanized steel: 3-inch high with 2-inch and 3-inch upper and lower horizontal legs.

E. Hardware:

1. Manufacturer's standard and listed hardware for attaching curtain wall insulation.
2. Mechanical fasteners: Provide per manufacturer's written instructions and per tested assembly.

F. Mullion Covers:

1. Manufacturer's standard mullion cover insulation product for protection of mullions.

a. Size: 1 inch or 2 inch, as required per tested assembly.

G. Backer / Reinforcement Member: Manufacturer's standard and listed reinforcing components or other light gauge steel channel or angle approved by the primary manufacturer. Place horizontally at the safe-off line to support curtain wall insulation to prevent bowing of curtain wall insulation caused by compression fitting of safing insulation.

H. Smoke Barrier: Smoke sealant as listed in the appropriate fire tested assembly and in compliance with perimeter fire containment manufacturer's written instructions.

I. Vaper Retarder Tape: Compatible with specified facer and comparable perm rating. Provide for taping insulation joints and repairing tears.

J. Accessories: Provide components of fire-resistive joint system, that are needed to install fill materials and to maintain ratings required. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing agency for systems indicated.

2.4 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD [I-1] (Exterior decks over conditioned spaces only)

A. Extruded polystyrene boards in this article are also called "XPS boards." Roman numeral designators in ASTM C 578 are assigned in a fixed random sequence, and their numeric order does not reflect increasing strength or other characteristics.

B. Extruded-Polystyrene Board Insulation, Type VII: ASTM C 578, Type VII, 60-psi minimum compressive strength, maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Dow Chemical Company (The).
b. Owens Corning.
c. Or Equal.

C. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

2.5 MINERAL-WOOL BOARD [I-2] (Continuous insulation in exterior walls)

A. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

1. Roxul, Inc.; "CavityRock MD."

2. Substitutions and Comparable Products will NOT be accepted. Specified manufacturer and product is only product compliant with NFPA 285 testing for fiber-cement siding system specified in Section 074646 "Fiber-Cement Siding."

B. Mineral-Wool Board, Types IVB, Unfaced: ASTM C 612, Types IVB; with maximum flame-spread and smoke-developed indexes of 0 and 0, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics. Nominal density of 4.4lb/cu. ft.

1. Thermal Resistance: Provide in thickness to comply with "Performance Requirements" article.

2.6 GLASS-FIBER BLANKET [I-3] (Between studs / joists/ in exterior walls / floors / soffits)

A. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

1. Johns Manville; "Formaldehyde-Free Fiberglass Insulation, Unfaced" (passing ASTM E 136).

B. Glass-Fiber Blanket, Unfaced: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

1. Thermal Resistance: Provide in thickness as indicated on Drawings and complying with "Performance Requirements" article.

2.7 INSULATION FASTENERS

A. As recommended by insulation manufacturer, for permanent mechanical attachment of insulation to substrate.

1. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide the following:

a. As recommended by primary insulation manufacturer.
b. For exterior wall continuous insulation systems:

1) Rodenhouse Inc.; http://rodenhouse-inc.com/brand/roxul/

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

B. Proceed with installation only after unsatisfactory conditions have been corrected

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.3 INSTALLATION OF PERIMETER FIRE CONTAINMENT SYSTEM

A. Install insulation and accessories in accordance with Underwriters Laboratories / Intertek (OPL) Laboratories listed system and manufacturer’s instructions.

B. Retain insulation in place with mechanical fasteners within the mullions and transoms (spandrel area), spaced at intervals recommended by tested assembly to hold insulation securely in place without touching the exterior wall. Maintain cavity width of dimension indicated between insulation and exterior wall.

C. Comply with execution requirements in Section 078443 “Joint Firestopping.”

3.4 INSTALLATION OF EXTERIOR WALL INSULATION

A. Apply insulation units to substrates by mechanical attachment, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with mechanical anchorage to provide permanent placement and support of units.

3.5 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Continuous Insulation Installation:

1. Comply with manufacturer's written instruction and the following:

a. Attach insulation boards to open framing with mechanical fasteners per manufacturer's recommendation.
b. Attach in courses with vertical joints staggered.
c. Cut insulation board in an "L" shape around openings. Tightly abut insulation board joints and interlock inside and outside corners. Trim or rasp board flush for square corners.
d. Seal gaps or open joints.
e. Do not allow insulation board to be exposed to weather for a duration exceeding manufacturer's written limitations.

C. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

D. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Loose-Fill Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft..
2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

3.6 INSTALLATION OF CURTAIN-WALL INSULATION

A. Install board insulation in curtain-wall construction where indicated on Drawings according to curtain-wall manufacturer's written instructions.

1. Hold insulation in place by securing metal clips and straps or integral pockets within window frames, spaced at intervals recommended in writing by insulation manufacturer to hold insulation securely in place without touching spandrel glass. Maintain cavity width of dimension indicated between insulation and glass.
2. Install insulation where it contacts perimeter fire-containment system to prevent insulation from bowing under pressure from perimeter fire-containment system.

3.7 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Where deficiencies are found or systems are damaged or removed due to testing, repair or replace fire-resistive joint systems so they comply with requirements.

C. Proceed with enclosing systems with other construction only after inspection reports are issued and installations comply with requirements.

3.8 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

SECTION 072713 - MODIFIED BITUMINOUS SHEET AIR BARRIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes high-temperature-rated, NFPA-285-compliant, self-adhering, vapor-retarding, modified bituminous sheet air barriers [AB-1], and accessories.

B. Related Requirements:

1. Section 042200 "Concrete Unit Masonry (CMU)" for CMU substrates.
2. Section 061600 "Sheathing" for wall sheathings and wall sheathing joint-and-penetration treatments.

1.3 DEFINITIONS

A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.

B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.

C. Air-Barrier Assembly: The collection of air-barrier materials and accessories applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.4 COORDINATION

A. Coordinate installation of modified bituminous sheet air barriers with fenestration, doors, and other exterior wall openings, penetrations, and flashings to provide an air- and weather-tight barrier assembly.

B. Schedule and coordinate installation of air barrier and exterior cladding materials to minimize air barrier's direct exposure to UV and weather. Comply with air barrier manufacture's published limitations for exposure.

C. Coordinate CMU installations indicated to receive modified bituminous sheet air barriers such that CMU mortar joints are struck flush with the face of block.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Construction Manager, Architect, envelope consultant, inspection agency, air barrier installer, air barrier manufacturer's technical representative, and installers whose work interfaces with or affects modified bituminous sheet air barriers, including installers of adjacent construction that penetrates waterproofing system.
2. Review air-barrier requirements, including, but not limited to, the following:

a. Installation.
b. Special details.
c. Mockups.
d. Air-leakage and bond testing.
e. Air barrier protection.
f. Work scheduling of product(s) that cover air barriers.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; and tested physical and performance properties of products.

B. Sustainable Design Submittals: For primers, product data indicating VOC content.

C. Shop Drawings: For air-barrier assemblies.

1. Provide project-specific shop drawings showing locations and extent of air barrier materials, accessories, and assemblies specific to Project conditions.
2. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
3. Include details of interfaces with other materials that form part of air barrier.

D. Samples:

1. Sheet air barrier, 8 inches square.
2. Accessories, full size.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

1. Include list of ABAA-certified installers and supervisors employed by Installer, who work on Project.

B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with air barrier.

C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.

D. Inspection Report: Copy of air barrier manufacturer’s inspection of completed air barrier system installation.

E. Field quality-control reports.

F. Sample Warranties: For special warranties.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years’ experience regularly engaged in the production and sales of modified bituminous sheet air barriers that have been used for similar applications with successful results, that meets or exceeds performance requirements indicated, and of documenting this performance by inclusion in test reports. Manufacturer shall have factory-authorized service representatives who are available for consultation, periodic Project-site observations, and on-site assistance.

1. Manufacturer shall have NFPA 285 test data conducted on configurations for exterior wall systems designs matching those proposed for Project, and shall have a valid research/evaluation report permitting sheet air barrier system in exterior walls of construction types I, II, III, and IV over 40 feet in height. Manufacturer shall also be listed by the Air Barrier Association of America (www.airbarrier.org).

B. Installer Qualifications: A firm with not less than 10 years’ experience installing modified bituminous sheet air barriers similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

1. Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.
2. Installer or sheet air barrier shall also be same installer as for overburden/cladding material in order to be eligible for special weathertightness warranty specified.

C. Mockups: Build mockups to set quality standards for materials and execution.

1. Build integrated mockups of exterior wall assembly as indicated on Drawings, incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.

   a. Coordinate construction of mockups to permit inspection and testing of air barrier before external insulation and cladding are installed.
   b. Include junction with roofing membrane, building corner condition, and foundation wall intersection.
   c. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Remove and replace liquid materials that cannot be applied within their stated shelf life.

B. Protect stored materials from direct sunlight.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended in writing by air-barrier manufacturer.

1. Protect substrates from environmental conditions that affect air-barrier performance.
2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

1.11 WARRANTY

A. Special Weathertightness Warranty: Sheet air barrier mmanufacturer's standard or customized warranty, in which sheet air barrier manufacturer and overburden/cladding installer agree to repair or replace components of modified bituminous sheet air barrier system, including sheet air barrier, flashings, sealants, and associated accessories, that do not comply with requirements or that fail to remain air and/or watertight within specified warranty period.

1. Warranty includes removing and reinstalling air barriers, flashing, accessories, substrates and overburdens.
2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide the following:

1. Carlisle Coatings & Waterproofing Inc.; CCW-705 HT.

2. Substitutions and Comparable Products will NOT be accepted. Specified manufacturer and product is only product compliant with NFPA 285 testing for fiber-cement siding system specified in Section 074646 "Fiber-Cement Siding."

B. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction shall be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., when tested according to ASTM E 283 and ASTM E 2357.

C. Product shall be listed as an air barrier per the Air Barrier Association of America (www.airbarrier.org).

D. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

1. Manufacturer shall have NFPA 285 test data conducted on configurations for exterior wall systems designs matching those proposed for Project.

E. High-Temperature-Rated Service Temperature: Stable up to minimum 180 degrees F per ASTM D1204.

2.3 SELF-ADHERING SHEET AIR BARRIER

A. Modified Bituminous Sheet: 40-mil-thick, self-adhering sheet consisting of 36 mils of rubberized asphalt laminated to a 4-mil-thick, cross-laminated polyethylene film with release liner on adhesive side and formulated for application with primer that complies with VOC limits.

1. Physical and Performance Properties:

a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 2178.
b. Tensile Strength: Minimum 250 psi; ASTM D 412, Die C.
c. Ultimate Elongation: Minimum 200 percent; ASTM D 412, Die C.
d. Puncture Resistance: Minimum 40 lbf; ASTM E 154.
e. Water Absorption: Maximum 0.15 percent weight gain after 48-hour immersion at 70 deg F; ASTM D 570.
f. Vapor Permeance: Maximum 0.1 perm; ASTM E 96, Desiccant Method.
g. Adhesion to Substrate: Minimum 16 lbf/sq. in. when tested according to ASTM D 4541 as modified by ABAA.
h. UV Resistance: Can be exposed to sunlight for 30 days according to manufacturer's written instructions.
i. Service Temperatures: Resists temperatures up to 240 deg F without degradation or flow of adhesive.

2.4 ACCESSORY MATERIALS

A. Requirement: Provide primers, transition strips, termination strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.

B. Primer: Liquid waterborne primer recommended for substrate by air-barrier material manufacturer.

1. Primer shall have a maximum VOC content of 100 g/L.

C. Stainless-Steel Sheet: ASTM A 240, Type 304, 0.0187 inch thick, and Series 300 stainless-steel fasteners.

D. Preformed Silicone Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
2. Engage air barrier manufacturer’s technical representative to inspect substrate conditions prior to application of air barrier system. Obtain manufacturer’s written acceptance of substrate conditions and submit to Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate according to manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.

E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

H. Bridge isolation joints, expansion joints, and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement according to manufacturer's written instructions and details.

3.3 INSTALLATION

A. Install materials according to air-barrier manufacturer's written instructions and details and according to recommendations in ASTM D 6135 to form a seal with adjacent construction and ensure continuity of air and water barrier.

1. When ambient and substrate temperatures range between 25 and 40 deg F, install self-adhering, modified bituminous air-barrier sheet produced for low-temperature application.
2. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.

B. Prepare, treat, and seal inside and outside corners and vertical and horizontal surfaces at terminations and penetrations with termination mastic and according to ASTM D 6135.

C. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier sheet on same day. Reprime areas exposed for more than 24 hours.

D. Apply and firmly adhere air-barrier sheets over area to receive air barrier. Accurately align sheets and maintain uniform 2-1/2-inch-minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure airtight installation.

1. Apply sheets in a shingled manner to shed water.
2. Roll sheets firmly to enhance adhesion to substrate.

E. Apply continuous air-barrier sheets over accessory strips bridging substrate cracks, construction, and contraction joints.

F. CMU: Install air-barrier sheet horizontally against the CMU beginning at base of wall. Align top edge of air-barrier sheet immediately below protruding masonry ties or joint reinforcement or ties, and firmly adhere in place.

1. Overlap horizontally adjacent sheets a minimum of 2 inches and roll seams.
2. Apply overlapping sheets with bottom edge slit to fit around masonry reinforcing or ties. Roll firmly into place.
3. Seal around masonry reinforcing or ties and penetrations with termination mastic.
4. Continue the sheet into all openings in the wall, such as doors and windows, and terminate at points to maintain an airtight barrier that is not visible from interior.

G. Weatherlap through-wall flashings with sheet air barriers to create an air and watertight envelope.

H. Seal exposed edges of sheet at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

I. Install air-barrier sheet and accessory materials to form a seal with adjacent construction and to maintain a continuous air barrier.

1. Coordinate air-barrier installation with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
2. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over each substrate.

J. Connect and seal exterior wall air-barrier sheet continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

K. At end of each working day, seal top edge of air-barrier material to substrate with termination mastic.

L. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

M. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip so that a minimum of 3 inches of coverage is achieved over each substrate. Maintain 3 inches of contact over firm bearing to perimeter frames, with not less than 1 inch of full contact.

1. Transition Strip: Roll firmly to enhance adhesion.
2. Preformed Silicone Extrusion: Set in full bed of silicone sealant applied to walls, frame, and air-barrier material.

N. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, doors, and miscellaneous penetrations of air-barrier material with foam sealant.

O. Repair punctures, voids, and deficient lapped seams in air barrier. Slit and flatten fishmouths and blisters. Patch with air-barrier sheet extending 6 inches beyond repaired areas in all directions.

P. Do not cover air barrier until it has been tested and inspected by testing agency.

Q. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.4 FIELD QUALITY CONTROL (BY OWNER)

A. Testing Agency: Owner may engage a qualified testing agency to perform tests and inspections.

B. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:

1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
2. Continuous structural support of air-barrier system has been provided.
3. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
4. Site conditions for application temperature and dryness of substrates have been maintained.
5. Maximum exposure time of materials to UV deterioration has not been exceeded.
6. Surfaces have been primed.
7. Laps in sheet materials have complied with the minimum requirements and have been shingled in the correct direction (or mastic applied on exposed edges), with no fishmouths.
8. Termination mastic has been applied on cut edges.
9. Air barrier has been firmly adhered to substrate.
10. Compatible materials have been used.
11. Transitions at changes in direction and structural support at gaps have been provided.
12. Connections between assemblies (air barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
13. All penetrations have been sealed.

C. Air barriers will be considered defective if they do not pass tests and inspections.

1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
2. Remove and replace deficient air-barrier components for retesting as specified above.

D. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

3.5 FIELD QUALITY CONTROL (BY CONTRACTOR)

A. Manufacturer's Field Service: Contractor shall engage a manufacturer’s technical representative for technical assistance and guidance for installation of modified bituminous sheet air barriers. At a minimum, arrange for manufacturer’s technical representative to observe installation of modified bituminous sheet air barriers during mock-up, initial installation, at mid-point of the installation, and at completion. Provide additional field observation as required to obtain warranty specified and when requested by Architect or Owner. After each field visit, submit manufacturer’s written report of observations within 3 working days. The report shall note overall quality of work, deficiencies, and any other concerns, and recommend corrective action.

B. ABAA Quality Assurance Program: Perform examinations, preparation, installation, testing, and inspections under ABAA's Quality Assurance Program.

C. Tests: In addition to conducting field quality control tests specified in other Division 08 Sections, conduct the following field quality control tests:

1. Water Penetration: Air-barrier assemblies will be tested for water penetration according to ASTM E 1105.
2. Air-Leakage-Volume Testing: Air-barrier assemblies will be tested for air-leakage rate according to ASTM E 783.
3. Adhesion Testing: Air-barrier assemblies will be tested for required adhesion to substrate according to ASTM D 4541 for each 600 sq. ft. of installed air barrier or part thereof.
4. Perform a minimum of three tests in areas as directed by Envelope Consultant.
5. Perform tests in each test area as directed by Envelope Consultant. Perform at least three tests prior to 10, 35, and 70 percent completion.

D. Air barriers will be considered defective if they do not pass tests and inspections.

1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
2. Remove and replace deficient air-barrier components for retesting as specified above.

E. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

F. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

1. Protect air barrier from exposure to UV light and harmful weather exposure as recommended in writing by manufacturer. If exposed to these conditions for longer than recommended, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed materials according to air-barrier manufacturer's written instructions.
2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed Work, using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION 072713

SECTION 074646 - FIBER-CEMENT SIDING (DEFERRED APPROVAL)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes fiber-cement siding system.

1. System consists of fiber-cement siding panels, soffits, trim, attachment system components, miscellaneous metal framing, and accessories, whether indicated or not. Fiber-cement siding is part of a rain-screen system. System also includes application of sheet air barrier system. Coordinate with related requirements below to ensure an air- and watertight rain-screen system.

B. Work under this Section is part of a “Deferred Approval.” Coordinate with the deferred approval requirements in Section 013300 “Submittal Procedures” and with the requirements indicated on the Drawings.

C. Related Requirements:

1. Section 054000 "Cold-Formed Metal Framing" for cold-formed metal framing for exterior walls and for cold-formed metal accessories to the extent not provided as part of this Section.
2. Section 055000 "Metal Fabrications" for miscellaneous steel framing to the extent not provided as part of this Section.
3. Section 072713 "Modified Bituminous Sheet Air Barriers" for air and weather barriers below fiber cement siding systems. Installer of fiber-cement siding system provided under this Section shall be same installer as for sheet air barriers in order to be eligible for specified special weathertightness warranty.
4. Section 076200 “Sheet Metal Flashing and Trim” for flashing to the extent not provided as part of this Section.
5. Section 079200 “Joint Sealants” for joint sealants to the extent not provided as part of this Section.

1.3 COORDINATION

A. Coordinate siding installation with flashings and other adjoining construction to ensure proper sequencing.

B. Coordinate installation of anchorages for fiber-cement siding system. Furnish setting drawings, templates, and directions for installing anchorages, including miscellaneous metal subframing, backing, blocking, and furring components that are to be embedded or attached to supporting construction. Deliver such items to Project site in time for installation.

C. Coordinate with sheet air barrier installer to ensure that all penetrations through air/weather barrier are sealed to create an air and water-tight barrier system.

D. Pre-Installation Field Measurements: Coordinate exact hardware and anchorage locations with other Trade Contractors before permanently attaching to other construction.

E. Post-Installed Field Measurements: Field verify and examine actual installed locations of connection hardware and anchorage items prior to installation of Work provided under this Section. Notify General Contractor and Architect immediately of any discrepancies in writing. Provide letter from fiber-cement siding installer indicating acceptance of connection hardware and anchorage items.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Construction Manager, Architect, envelope consultant, inspection agency, fiber-cement siding installer, fiber-cement siding manufacturer's representative, structural-support installer, and installers whose work interfaces with or affects fiber-cement siding, including installers of entrances and curtain wall systems.
2. Review the following:

a. Finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
b. Methods and procedures related to fiber-cement siding installation, including manufacturer's written instructions.
c. Support conditions for compliance with requirements, including alignment between and attachment to structural members.
d. Continuity of air- and weather barrier system, flashings, special siding details, wall penetrations, openings, and condition of other construction that affect fiber-cement siding system.
e. Governing regulations and requirements for tests and inspections.
f. Temporary protection requirements for fiber-cement siding assembly during and after installation.
g. Procedures for repair of panels damaged after installation.

3. Contractor shall document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.5 ACTION SUBMITTALS

A. Transmit all action and informational submittal items together in one single complete submittal package for review.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include manufacturer's printed installation instructions.

C. Shop Drawings: Provide project-specific shop drawings for each type of fiber cement siding type and soffits.

1. Include fabrication and installation layouts of siding and soffits, details of edge conditions, joints, profiles, corners, anchorages, attachment assembly, closures, accessories, and special details.
2. Include interfaces with adjoining and adjacent systems.
3. Shop Drawings shall be stamped and signed by the qualified California-licensed professional engineer responsible for their preparation, including calculations, indicating compliance with performance requirements.

D. Samples for Initial Selection: For fiber-cement siding and soffit including related accessories.

E. Samples for Verification: For each type, color, texture, and pattern required.

1. 12-inch-long-by-actual-width Sample of siding.
2. 24-inch-wide-by-36-inch-high Sample panel of siding assembled on plywood backing.
3. 12-inch-long-by-actual-width Sample of soffit panels, trim, and accessories.

F. Deferred-Approval Submittal: For fiber-cement siding system indicated to comply with performance requirements and design criteria, including shop drawings, calculations, and analysis data stamped and signed by the qualified California-licensed professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Exterior elevations, 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 panels and attachments.
2. Stud framing.
3. Wall-mounted items including curtain wall system components, entrances, and lighting fixtures.
4. Penetrations of wall by pipes and utilities.
5. Air/weather barrier, sealants, roofing, and sheet metal flashing and trim.

B. Qualification Data: For manufacturer and installer.

C. Product Certificates: For each type of fiber-cement siding and soffit.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fiber-cement siding.

E. Fastener and Anchor Test Reports: Certified reports of last completed set of mechanical tests for each device.

F. Research/Evaluation Reports: For fire-cement siding system, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

G. Welding certificates.

H. Field quality-control reports.

I. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of product, including related accessories, to include in maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish full lengths of fiber-cement siding and soffit including related accessories, in a quantity equal to 2 percent of amount installed.

1.9 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of fiber-cement siding that has been used for similar applications with successful results, that meets or exceeds performance requirements indicated, and of documenting this performance by inclusion in test reports. Manufacturer shall have factory-authorized service representatives who are available for consultation, periodic Project-site observations, and on-site assistance. Manufacturer shall have a current research/evaluation report from ICC-ES or equivalent.

B. Installer Qualifications: A firm with not less than 10 years' experience installing fiber-cement siding similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

1. Installer of fiber-cement siding system shall also be same installer as for sheet air barrier system specified in Section 072713 "Modified Bituminous Sheet Air Barriers" in order to be eligible for special weathertightness warranty.

C. Engineering Responsibility: Prepare data for fiber-cement siding system, including Shop Drawings, based on testing and engineering analysis for manufacturer's standard units in systems similar to those indicated for the Project and submission of reports of tests performed on manufacturer's standard assemblies, stamped and signed by the qualified California-licensed professional engineer responsible for their preparation.

D. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code - Steel."

E. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for fabrication and installation.

1. Description: Incorporate fiber-cement siding mockup into integrated exterior mockup per Section 014000 "Quality Requirements."
2. Construct mockup in presence of manufacturer's technical representative.
3. Testing shall be performed on mockups according to requirements specified in other Sections.
4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with labels intact until time of use.

B. Store materials on elevated platforms, under cover, and in a dry location.

1.11 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit siding system to be installed according to manufacturer's written instructions and warranty requirements.

B. All components used in siding system must be protected from exposure to moisture before, during, and after installation.

C. Do not install siding materials that are wet, moisture damaged, and/or mold damaged.

1.12 WARRANTY

A. Special Product and Finish Warranty: Manufacturer agrees to repair or replace products that fail in materials, finish, or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including cracking and deforming.
b. Deterioration of materials beyond normal weathering.
c. Damage from hail, termite attacks, and/or rot.
d. Failure to remain non-combustible.
e. Peeling, cracking, flaking, or yellowing.
f. Discoloration or stains due to chalking on back or other surfaces below coating.
g. Surface erosion.

2. Warranty Period: 15 years from date of Substantial Completion.

B. Special Weathertightness Warranty: Sheet air barrier mmanufacturer's standard or customized warranty in which sheet air barrier manufacturer and installer of fiber-cement siding system agree to repair or replace components of fiber-cement siding system, including sheet air barriers, flashings, sealants, and associated accessories that do not comply with requirements or that fail to remain air and/or watertight within specified warranty period.

1. Warranty includes removing and reinstalling fiber-cement siding system, air barriers, flashings, accessories, substrates and overburdens.
2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

1. Equitone Inc.; 1731 Fred Lawson Drive, Maryville, TN 37801 (865-268-2705).

a. Equitone "Tectiva."

B. Source Limitations: Obtain fiber-cement siding products, including related accessories, from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General: Fiber-cement siding system shall comply with the 2016 California Building Code.

B. Structural Performance: Provide fiber-cement siding systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 330:

1. Wind Loads: As indicated on Drawings.
2. Seismic Loads: As indicated on Drawings.
3. Frame Deflection Limits: For wind loads, normal to the plane of the wall between supports, deflection of the secured perimeter framing members shall not exceed 1/175 of the span or 3/4 inch, whichever is less.
4. Panel Deflection Limits: For wind loads, normal to the plane of the wall, the maximum panel deflection shall not exceed 1/100 of the span.

C. Pressure Equalized Rain Screen System: Comply with AAMA 508-05 “Voluntary Test Method and Specification for Pressure Equalized Rain Screen Wall Cladding Systems.”

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

E. Fire-Test-Response Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame Spread Index: 0.
2. Smoke Developed Index: 10 or less.
3. Combustion Characteristics:

a. Noncombustible when tested according to ASTM E 136, or
b. Vertical and Lateral Flame Propagation: Comply with 2016 CBC Section 1403.5, including testing in accordance with and compliance with the acceptance criteria of NFPA 285.

1) If test data is not provided, manufacturer shall have a valid evaluation report indicating compliance with the 2015 IBC (2016 CBC).

F. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

2.3 FIBER-CEMENT SIDING

A. General: ASTM C 1186, Type A, Grade IV, fiber-cement board.

1. Color: As indicated on Drawings, or if not indicated, as selected from manufacturer's full range of standard and optional colors.

B. Labeling: Provide fiber-cement siding that is tested and labeled according to ASTM C 1186 by a qualified testing agency acceptable to authorities having jurisdiction.

C. Nominal Thickness: Not less than 5/16 inch.

D. Panel Texture: Rough orange-peel texture.

E. Factory Coating: Manufacturer's standard double acrylic coating.

F. Panel Height and Width: As indicated on Drawings.

2.4 FIBER-CEMENT SOFFIT

A. General: ASTM C 1186, Type A, Grade IV, fiber-cement board.

1. Basis-of-Design Product: Subject to compliance with requirements, provide fiber-cement soffits by same manufacturer as fiber-cement siding.

B. Nominal Thickness: Not less than 5/16 inch.

C. Panel Texture: Matching fiber-cement siding.

D. Factory Priming: Matching fiber-cement siding.

E. Panel Height and Width: As indicated on Drawings.

2.5 ACCESSORIES

A. Siding Accessories, General: Provide starter strips, edge trim, outside and inside corner caps, and other items as recommended by siding manufacturer for building configuration.

1. Provide accessories matching color and texture of adjacent siding unless otherwise indicated.

B. Decorative Accessories: Provide fiber-cement decorative accessories as indicated.

C. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet ASTM A 653, G90 coating designation or ASTM A 792, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections for support and alignment of fiber-cement siding system in accordance with performance requirements and approved Shop Drawings.

D. Air and Weather Barrier: As specified in Section 072713 "Modified Bituminous Sheet Air Barriers."

E. Z-Shaped Furring: As specified in Section 054000 "Cold-Formed Metal Framing."

F. Continuous Insulation: As specified in Section 054000 "Thermal Insulation."

G. Flashing: Provide aluminum flashing complying with Section 076200 "Sheet Metal Flashing and Trim" at heads of fenestration, entrances, and where indicated.

1. Finish for Aluminum Flashing:

a. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
b. Color: As indicated on Drawings, of if not indicated, custom color to match Architect's sample.

H. Fasteners:

1. For concealed metal-to-metal connections, use ribbed bugle-head screws of sufficient length to penetrate a minimum of 1/4 inch, or three screw-threads, into substrate, and complying with performance requirements, from the following materials:

    a. Stainless steel.
    b. Galvanized steel, coated with Elco Stalgard corrosion resistant protective coating.

2. For exposed fasteners for anchoring fiber cement panels, use manufacturer's stainless steel blind rivets with colored heads to match panels.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, fiber-cement siding supports, and other conditions affecting performance of the Work.

1. Examine wall framing to verify that studs and other structural panel support members and anchorage have been installed within alignment tolerances required by fiber-cement siding manufacturer.
2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by fiber-cement siding manufacturer.

    a. Verify that sheet air barriers have been installed over sheathing or backing substrate to prevent air infiltration and water penetration.

B. Examine roughing-in for components and assemblies penetrating fiber-cement siding to verify actual locations of penetrations relative to seam locations of fiber-cement siding before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

B. Confirm application of weather barrier has been successfully completed and inspected in accordance with Section 072713 "Modified Bituminous Sheet Air Barriers." Ensure that drainage plane is intact, all penetrations are sealed, and air barrier assembly has passed all tests and inspections.

C. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and fiber-cement siding manufacturer's written recommendations.

D. Do not begin installation until unacceptable conditions have been corrected.

3.3 INSTALLING AIR AND WEATHER BARRIER

A. Install air and weather barrier as specified in Section 072713 "Modified Bituminous Sheet Air Barriers."

3.4 INSTALLING Z-FURRING SHAPES AND CONTINUOUS INSULATION

A. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 16 inches o.c.

B. Except at exterior corners, securely attach narrow flanges of furring members to wall framing with screws not exceeding 16 inches on center.

C. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of adjacent channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.

3.5 INSTALLATION

A. General: Install fiber-cement siding system according the manufacturer's written installation instructions and approved test assemblies, in orientations, sizes, and locations indicated on Drawings. Install siding perpendicular to supports unless otherwise indicated. Anchor fiber-cement siding panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Commence initial installation in presence of manufacturer’s technical support representative.
2. Shim or otherwise plumb substrates receiving fiber-cement siding.
3. Rain Screen-Principle Installation: Air space inlets and outlets are required at top and bottom of building or wall termination and shall be equivalent to a continuous 1/2 to 3/4 inch to facilitate airflow behind the panels. Do not block vertical airflow at fenestration, entrances, eaves, or at the base of the building. Airflow shall be continuous from bottom to top so there is air movement behind each panel. The minimum cavity width should be at least 25/32 inch for facades up to 33 feet high. For facades between 66-165 feet, the cavity width shall be increase to 1-3/16 inch. Air flow behind the fiber cement panels is critical to the performance of the rain screen construction.
4. Fasteners in profile shall accommodate thermal expansion/contraction of metal and not interfere with panel application.
5. Install panels starting from top of building and work down the facade.
6. For straight walls, start panel installation in center and work outward.
7. For walls with inside corners, start installation at corner and work across wall.

3.6 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align fiber-cement siding units within installed tolerance of 1/4 inch in 20 feet, non-accumulative, on level, plumb, and location lines as indicated, and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.7 FIELD QUALITY CONTROL (BY OWNER)

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Field and shop welds in compliance with CBC 1705.2.
2. Post-installed concrete anchors in compliance with CBC 1705.3.

B. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

D. Fiber-cement siding system will be considered defective if it does not pass tests and inspections.

3.8 FIELD QUALITY CONTROL (BY CONTRACTOR)

A. Manufacturer's Field Service: Contractor shall engage a manufacturer’s technical representative for technical assistance and guidance for installation of fiber-cement siding system. At a minimum, arrange for manufacturer’s technical representative to observe installation of system during mockup, initial installation, at mid-point of the installation, and at completion. Provide additional field observation as required to obtain warranty specified and when requested by Architect or Owner. After each field visit, submit manufacturer’s written report of observations within 3 working days. The report shall note overall quality of work, deficiencies, and any other concerns, and recommend corrective action.

1. Final Inspection: Arrange for manufacturer’s technical personnel to inspect fiber-cement siding system upon completion of installation.

B. If test results or inspections show fiber-cement siding system does not comply with requirements, remove and replace or repair the fiber-cement siding system as recommended in writing by the manufacturer, and make further repairs after retesting and inspecting until system installation passes. Repair damage caused by testing; follow manufacturer's written instructions.

C. Prepare test and inspection reports.

3.9 ADJUSTING AND CLEANING

A. Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.

B. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION 074646

SECTION 075419 - POLYVINYL-CHLORIDE (PVC) ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fully-adhered polyvinyl-chloride (PVC) roofing system.
2. Cover boards.
3. Rigid insulation [I-6].
4. Substrate boards.
5. Vapor retarder.
6. Flexible walkways rolls.
7. Fasteners, adhesives and other accessories required for a complete roofing installation, whether indicated or not.
8. Prefabricated flashings, corners, parapets, stacks, vents and related details.

B. Related Requirements:

1. Section 054000 "Cold-Formed Metal Framing" for galvanized steel framing and accessories.
2. Section 077101 "Manufactured Copings" for source limitations for manufactured copings warranted by roofing system manufacturer provided under this Section.
3. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
4. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.
5. Section 221423 "Storm Drainage Piping Specialties" for roof drains.

1.3 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.

1.4 PREINSTALLATION MEETINGS

A. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at Project site.

1. Meet with Owner, Construction Manager, Architect, envelope consultant, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review roofing requirements, including, but not limited to, the following:

a. Methods and procedures related to roofing installation, including manufacturer's written instructions.
b. Finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
c. Deck substrate requirements for conditions and finishes, including flatness and fastening.
d. Structural loading limitations of roof deck during and after roofing.
e. Base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
f. Governing regulations and requirements for insurance and certificates if applicable.
g. Temporary protection requirements for roofing system during and after installation.
h. Roof observation and repair procedures after roofing installation.

1.5 ACTION SUBMITTALS

A. Transmit all action and informational submittal items together in one single complete submittal package for review.

B. Product Data: For each type of product.

C. Sustainable Design Submittals: For adhesives and sealants, product data for VOC content.

D. Shop Drawings: Provide project-specific shop drawings for roofing system. Include plans, elevations, sections, details, and attachments to other work, including:

1. Base flashings and membrane terminations.
2. Tapered insulation, including slopes. Include insulation adhesive bead sizing and spacing in the field, perimeter, and corner zones.
3. Roof plan showing orientation of roof deck and orientation of roofing, fastening spacings, and patterns for mechanically fastened roofing.
4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

E. Samples for Verification: For the following products:

1. Sheet roofing, of color required.
2. Walkway pads or rolls, of color required.
3. Roof insulation.
4. Cover board.
5. Metal termination bars.
6. Fasteners for insulation.
7. Fasteners for barrier boards.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Manufacturer Certificates: Signed by roofing manufacturer certifying that :

1. Roofing system complies with requirements specified in "Performance Requirements" Article.

a. Submit evidence of compliance with performance requirements.

2. Roofing materials are compatible with one another and with adjacent construction materials interfacing with PVC roofing system.

C. Product Test Reports: For components of roofing system, for tests performed by manufacturer and witnessed by a qualified testing agency.

1. Test reports shall be preferably less than 5 years old, and shall not exceed 10 years old.

D. Research/Evaluation Reports: For components of roofing system, from ICC and Miami Dade.

E. Field quality-control reports.

F. Sample Warranties: For manufacturer's special warranties.

G. Letter from manufacturer and installer indicating acceptance of substrate prior to installation of roofing system.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 20 years' experience regularly engaged in the production and sales of fully-adhered polyvinyl-chloride roofing systems that have been used for similar applications with successful results, that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports. Manufacturer shall have factory-authorized service representatives who are available for consultation, periodic Project-site observations, and on-site assistance. Manufacturer shall also be UL listed and FM Global approved for roofing systems identical to that used for this Project.

B. Installer Qualifications: A firm with not less than 10 years' experience installing polyvinyl-chloride roofing systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section. Installer shall be licensed and eligible to receive manufacturer's special warranty.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Examine materials that may have been damaged during transport. Reject materials that are wet, moisture damaged, and/or mold damaged.

C. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

D. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protect prior to, during, and after installation.

E. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.10 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

B. All components used in roofing system, including, but not limited to, roof boards, must be protected from exposure to moisture before, during, and after installation.

C. Do not install roofing materials that are wet, moisture damage, and/or mold damaged.

1.11 COORDINATION

A. Coordinate roofing installation with air/weather barriers, flashing, trim, wall and glazing construction, and other adjoining work to provide a watertight, airtight, secure, and noncorrosive installation.

1.12 WARRANTY

A. Special Warranty: Manufacturer's standard or customized form, without monetary limitation, in which manufacturer and installer agree to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period. Warranty shall not exclude the condition of ponding water and no time limit shall be assigned to any such ponding water during the warranty period. Warranty shall provide for maximum wind speed as indicated on the Structural Drawings.

1. Special warranty includes membrane roofing, flashings, roof insulation, fasteners, substrate boards, cover boards, vapor retarders, drainage boards, roofing accessories, and other components of membrane roofing system, including coping system as specified in Section 077101 "Manufactured Copings" and provided by same manufacturer as PVC roofing system.
2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide the following:

1. Sika Sarnafil, Inc.

B. Source Limitations: Obtain components including roof membrane, insulation, fasteners, adhesives, cover and barrier boards for roofing system from same manufacturer as membrane roofing.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing and base flashings shall remain watertight.

1. Accelerated Weathering: Roofing system shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
2. Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D 3746 or ASTM D 4272.

B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.

C. Roofing System Design: Tested by a qualified testing agency to resist the following uplift pressures:

1. Design Pressure: Per the 2016 California Building Code based upon maximum wind speed criteria indicated on the Structural Drawings.

D. Aged Solar Reflectance: Not less than 0.63 in accordance with the 2016 California Energy Code.

E. Thermal Emittance: Not less than 0.75 in accordance with the 2016 California Energy Code.

F. Exterior Fire-Test Exposure: ASTM E 108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

G. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

H. Visual Criteria: Subject to compliance with performance criteria above, provide roof membrane in colors indicated on Drawings, or if not indicated, as selected by Architect from manufacturer’s full range.

2.3 PVC ROOFING

A. PVC Sheet: ASTM D 4434, Type II, Grade I, fiberglass reinforced 9 oz. felt-backed PVC membrane.

1. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide the following:

a. Sika Sarnafil, Inc.; Sarnafil G410 fully-adhered feltbacked membrane.

2. Thickness: As required to meet performance requirements and warranty duration indicated, but no less than 60 mils.
3. Exposed Face Colors: As indicated on Drawings.
4. Physical Properties:

Parameters	ASTM Test Method	Required Physical Properties
Reinforcing Material	-	Fiberglass
Overall Thickness, min., inches (mm)	D638	0.058 inches
Tensile Strength, min., psi (MPa)	D638	1600 (11.1)
Elongation at Break, min. (machine x tranverse)	D638	270% / 250%
Seam strength*, min. (% of tensile strength)	D638	80
Retention of Properties After Heat Aging	D3045	-
Tensile Strength, min., (% of original)	D638	95
Elongation, min., (% of original)	D638	90
Tearing Resistance, min., lbf (N)	D1004	14 (63.0)
Low Temperature Bend, -40º F (-40º C)	D2136	Pass
Accelerated Weathering Test (Xenon Arc)	D2565	10,000 Hours
Cracking (7x magnification)	-	None
Discoloration (by observation)	-	Negligible
Crazing (7 x magnification)	-	None
Linear Dimensional Change	D1204	0.02%
Weight Change After Immersion in Water	D570	2.5%
Static Puncture Resistance, 33 lbf (15 kg)	D5602	Pass
Dynamic Puncture Resistance, 7.3 ft-lbf (10 J)	D5635	Pass

*Failure occurs through membrane rupture not seam failure.

2.4 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing.

1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
2. Adhesives and sealants shall comply with the following limits for VOC content:

a. Plastic Foam Adhesives: 50 g/L.
b. Gypsum Board and Panel Adhesives: 50 g/L.
c. Multipurpose Construction Adhesives: 70 g/L.
d. Fiberglass Adhesives: 80 g/L.
e. Contact Adhesives: 80 g/L.
f. PVC Welding Compounds: 510 g/L.
g. Other Adhesives: 250 g/L.
h. Single-Ply Roof Membrane Sealants: 450 g/L.
i. Nonmembrane Roof Sealants: 300 g/L.
j. Sealant Primers for Nonporous Substrates: 250 g/L.
k. Sealant Primers for Porous Substrates: 775 g/L.

B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as PVC sheet.

C. PVC Coated Metal Flashing: Flexible, non-reinforced PVC membrane laminated to hot-dipped galvanized steel.

D. Bonding Adhesive: Manufacturer's standard, water based.

E. Slip Sheet: Manufacturer's standard, of thickness required for application.

F. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel bars, approximately 1 by 1/8 inch thick; with anchors.

G. Fasteners and Insulation Plates: Factory-coated steel fasteners and corrosion-resistant metal or plastic plates, designed for fastening roofing to substrate, and acceptable to roofing system manufacturer as required to withstand roof wind uplift pressures for field, perimeter, and corner zones.

H. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

1. Pitch pans are not acceptable for use as penetration flashings for this Project.

2.5 VAPOR RETARDER

A. Self-Adhering-Sheet Vapor Retarder: ASTM D 1970, polyethylene film laminated to layer of rubberized asphalt adhesive, minimum 30-mil-total thickness; maximum permeance rating of 0.1 perm; cold applied, with slip-resisting surface and release paper backing. Provide primer when recommended by vapor-retarder manufacturer.

1. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

a. Sarnafil Inc.; Sarnavap - Self Adhered.

2. Source Limitation: Vapor retarder shall be provided and warranted by the primary roofing manufacturer.

B. Vapor retarder shall be applied over all decks, whether indicated or not.

1. On steel decks, use a minimum 22-gauge galvanized steel plate to support the vapor retarder end lap between metal flutes ensuring a complete end lap seal.

2.6 SUBSTRATE BOARDS

A. Substrate Boards: Fire-tested, substrate boards, supplied by PVC membrane roofing manufacturer, compatible with membrane application specified, of thickness indicated, and are listed in evaluation report(s) and/or test data.

1. Substrate Board: ASTM C 1278, gypsum-fiber-reinforced, water-resistant gypsum substrate.
2. Source Limitation: Substrate board shall be provided and warranted by the primary roofing manufacturer.

B. Adhesive: Roofing manufacturer’s proprietary two-component polyurethane-based low rise foam adhesive used in attaching insulation boards to the roof deck and cover boards.

C. Fasteners: Factory-coated corrosion-resistant steel fasteners and corrosion-resistant metal plates, designed for fastening insulation and cover boards to substrate, and acceptable to roofing system manufacture.

2.7 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured by PVC roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated and that are listed in evaluation report(s) and/or test data.

B. Polyisocyanurate Board Insulation [I-6]: ASTM C 1289, Type II, Class 1, Grade 2.

1. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

a. Sarnfail, Inc.; Sarnatherm.

1) Thickness: Provide in thickness indicated on Drawings, but no less that thickness required to achieve a minimum thermal resistance of R-25 per the project energy model.
2) Maximum Flame Spread: Not greater than 75 per ASTM E 84, at the maximum thickness intended for use.

2. Source Limitation: Insulation shall be provided and warranted by the primary roofing manufacturer.

C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to minimum slope of 1/4 inch per 12 inches unless otherwise indicated.

D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.8 INSULATION ACCESSORIES

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with roofing.

B. Fasteners: Factory-coated corrosion-resistant steel fasteners and metal or plastic plates, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.

C. Insulation Adhesive: As required by roofing manufacturer to meet the performance requirements and warranty duration indicated. Roofing manufacturer’s proprietary two-component polyurethane-based low rise foam adhesive used in attaching insulation boards to the roof deck and cover boards.

2.9 COVER BOARDS

A. Cover Board: Factory-primed fire-tested cover boards, supplied by PVC membrane roofing manufacturer, compatible with membrane application specified, of thickness indicated, and that are listed in evaluation report(s) and/or test data.

1. Substrate Board: ASTM C 1278, gypsum-fiber-reinforced, water-resistant gypsum substrate.
2. Source Limitation: Cover boards shall be provided and warranted by the primary roofing manufacturer.

B. Adhesive: Roofing manufacturer’s proprietary two-component polyurethane-based low rise foam adhesive used in attaching insulation boards to the roof deck and cover boards.

C. Fasteners: Factory-coated corrosion-resistant steel fasteners and corrosion-resistant metal plates, designed for fastening insulation and cover boards to substrate, and acceptable to roofing system manufacture.

2.10 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16 inch thick and acceptable to roofing system manufacturer.

2.11 ACCESSORIES

A. Provide separator felts where required to separate roofing membrane from contact with asphalt, coal tar pitch or any petroleum based product.

B. Membrane Leak-Detection System: Conductor cable, placed on top of membrane, delivering direct current tension to membrane surface, enabling inspection and isolation of points of moisture infiltration through membrane to conductive substrate under membrane.

1. Measurement Grid: Highly conductive stainless steel wire measurement grid located under membrane and above non-conductive membrane substrate, connected through contact plate and cable to connection box accepting low-voltage charge from portable pulse generator. Include conductor cable, measurement grid, connection box, and accessories for a complete membrane leak-detection system.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work:

1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
2. Verify that blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100 "Steel Decking."
4. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
5. Verify that concrete substrate is visibly dry and free of moisture.

a. Moisture Testing: Test for moisture using the methods indicated below or as recommended by PVC roofing manufacturer.

1) Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method: ASTM D 4263.
2) Anhydrous Calcium Chloride Test: ASTM F 1869.
3) Internal Relative Humidity Test: Using in situ probes, ASTM F 2170.

b. Where moisture levels exceed manufacturer's written limitations, implement remedial action(s) recommended by PVC roofing manufacturer. Proceed with installation only after substrates pass testing.

6. Verify that concrete-curing compounds that will impair adhesion of roofing components to roof deck have been removed.
7. Verify that curbs, pipes, conduits, and other roof penetrations are of adequate height to allow a minimum 8 inches of flashing height.
8. Prior to installation of vapor retarder, verify that steel deck and substrate boards are not damaged, substrate tolerance comply with manufacturer’s written requirements, and substrates are suitable to receive vapor retarder.

B. Examine stored materials before installation. Reject materials that are wet, moisture damaged, and/or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

D. Sharp ridges or other projections above the surface of the roof shall be removed before roofing. A concrete surface profile of CSP 3 to CSP 6 is required. Achieve concrete surface profile in accordance with the ICRI Technical Guideline No. 310.2R-2013.

3.3 VAPOR RETARDER

A. Over Structural Concrete and Steel Deck Substrates: Install self-adhered vapor retarder over a clean and dry substrate. In concrete applications, allow concrete to cure for a least 7 days. Do not install when it is raining, snowing, or on wet / humid surfaces. Install in temperatures 32 degrees F and above. The use of a primer is required on the following substrates: concrete, lightweight concrete, gypsum boards and decks, and Dens Deck boards.

B. Over Other Deck Substrates: Install self-adhered vapor retarder over a clean and dry deck. Do not install when it is raining, or on wet / humid surfaces. Install in temperatures 32 degrees F and above. Prime decks in accordance with manufacturer’s written instructions.

C. Install vapor retarder in accordance with manufacturer’s written instructions.

D. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into roofing system.

E. Prior to covering vapor retarder, inspect the surface for damage. Repair all damage to maintain continuous vapor retarder.

3.4 SUBSTRATE BOARD INSTALLATION

A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.

1. Fasten substrate board to deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturers' written instructions and test reports.

3.5 INSULATION INSTALLATION

A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Install tapered insulation under area of roofing to conform to slopes indicated. Coordinate insulation valley locations with roof penetrations; relocate valley slightly upslope to prevent penetrations within 12 inches of valley centerline.

D. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.5 inches or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction. Staggered joints shall be maintained at daily terminations. Joints in subsequent layers shall not align.

E. At roof drains, do not trim insulation. Use insulation sumps, minimum 4-foot square, so completed surface is flush and does not restrict flow of water.

F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.

1. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.

G. Adhered Insulation Over Vapor Barrier Over Structural Concrete Deck: Install each layer of insulation and adhere to substrate as follows:

1. Adhere insulation according to manufacturer's written installation instructions and test reports.
2. Adhere insulation to comply with performance requirements at corner, perimeter, and field of roof.

H. Mechanically Fastened Insulation Over Vapor Retarder Over Structural Concrete Deck: Install each layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.

1. Adhere insulation according to manufacturer's written installation instructions and test reports.
2. Fasten insulation to resist uplift pressure at corners, perimeter, and field of roof.

3.6 COVER BOARD

A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction.

1. Structural Concrete Substrates: Adhere cover boards to insulation according to manufacturer's written installation instructions and test reports. Adhere cover boards to insulation to comply with performance requirements at corners, perimeter, and field of roof.
2. Steel Deck Substrates: Fasten cover boards to insulation and steel deck according to manufacturer's written installation instructions and test reports. Fasten cover boards to insulation and steel deck to comply with performance requirements at corners, perimeter, and field of roof.
3. Cut cover board along valley lines to preserve valley slope. Trim sheets for tight fit or gap as required by cover board manufacturer.

3.7 ROOFING INSTALLATION, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions, unless more stringent requirements apply based upon tested assemblies representative of that indicated for this Project.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

C. Coordinate installation of roofing materials so that substrate boards, insulation, cover boards, and other similar roofing materials are not exposed to precipitation or left exposed at the end of the workday.

3.8 FULLY-ADHERED ROOFING MEMBRANE INSTALLATION

A. Adhere roofing over area to receive roofing according to roofing system manufacturer's written instructions. Unroll roofing and allow to relax before retaining.

1. Install sheet according to ASTM D 5036.

B. Start installation of roofing in presence of roofing system manufacturer's technical personnel.

C. Accurately align roofing, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Bonding Adhesive: Apply to substrate and underside of roofing at rate required by manufacturer, and allow to partially dry before installing roofing. Do not apply to splice area of roofing. Where recommended by the roofing manufacturer, roll membrane with proper roller to gain full adhesion and eliminate wrinkles, blisters, and other unadhered portions of roofing membrane.

E. In addition to adhering, mechanically fasten roofing securely at terminations, penetrations, and perimeter of roofing as required by roof membrane manufacturer.

F. Apply membrane roofing with side laps shingled with slope of roof deck where possible.

G. Seams: Clean seam areas, overlap roofing, and hot-air weld side and end laps of roofing and sheet flashings according to manufacturer's written instructions, to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet.
2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roofing that do not comply with requirements.

H. Spread sealant bed over deck-drain flange at roof drains, and securely seal roofing in place with clamping ring.

I. Install perimeter bar at 4-feet and 8-feet spacing with cover strip throughout building perimeter only as required to satisfy wind speed warranty requirement.

3.9 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing. Where recommended by the roofing manufacturer, roll membrane flashing with proper roller to gain full adhesion and eliminate wrinkles, blisters, and other unadhered portions of roofing membrane.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

1. Use prefabricated membrane boots to the greatest extent possible, with field-wrapped flashings only as a last option when no other flashing is adequate.

D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate at 8 inches on center maximum through termination bars.

F. Coordinate flashing installation with adjoining air/weather barrier, sealant, etc. to ensure that system is fully and continuously air and water tight.

3.10 WALKWAY INSTALLATION

A. Flexible Walkways: Install walkway products in locations indicated. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

1. Do not install walkways in a manner or location that will impede drainage.

3.11 ELECTRONIC LEAK DETECTION GRID INSTALLATION

A. Measurement Grid: Install measurement grid on membrane substrate immediately under membrane and immediately prior to installation of membrane.

1. Verify that location of measurement grid fasteners does not interfere with or cause damage to membrane.
2. Fasten measurement grid in accordance with leak detection system manufacturer's requirements.
3. Do not place measurement grid where it will be in continuous direct contact with structural components.
4. Provide minimum 2 inch overlap where adjacent sheets meet, including side laps and end laps.
5. Cut measurement grid as close as possible to the perpendicular strand at both end and side edges

B. Conductor Wire: Install conductor wire on top of membrane at spacing and layout indicated on approved shop drawings.

C. Secure conductor wire using method recommended by manufacturer.

3.12 FIELD QUALITY CONTROL (BY OWNER)

A. Testing Agency: Owner will engage a qualified testing agency to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components, and to furnish reports to Architect.

1. Electric Field Vector Mapping (EFVM): Testing agency shall survey entire roof area for potential leaks using electric field vector mapping (EFVM).
2. Other testing protocols may be implemented at the discretion of the testing agency to evaluate installed conditions.

B. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.13 FIELD QUALITY CONTROL (BY CONTRACTOR)

A. Manufacturer's Field Services: Manufacturer's technical representative shall provide technical assistance and guidance for preparation and application of PVC roofing system. At a minimum, arrange for manufacturer's technical representative to observe PVC roofing system during mockup, first 20 squares of membrane and flashing installation, at mid-point of the installation, and at completion. Provide additional field observations as required to obtain warranty specified and when requested by Architect or Construction Manager. After each field visit, submit manufacturer's written report of observations within 3 working days. The report shall note overall quality of work, deficiencies, any other concerns, and recommended corrective action.

B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.

C. Roof Drain Test: After completing roofing, but prior to Substantial Completion, perform the following test for watertightness. Plug roof drains and fill with water to edge of drain sump for 8 hours. Do not plug secondary overflow drains at the same time as adjacent primary drain. To ensure some drainage from roof, do not test all drains at the same time. Measure water at beginning and end of the test period. When precipitation occurs during test period, repeat test. When water level falls, remove water, thoroughly dry, and inspect installation; repair or replace roofing at drain to provide for a properly installed watertight flashing seal. Repeat test until there is no water leakage.

1. When testing overflow drains, confirm that overflow drains are operating as intended.
2. Owner will engage an independent testing agency to observe roof drain test and examine underside of decks and terminations for evidence of leaks during roof drain testing.

D. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.14 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Coordinate with trades that will be working on or near the completed roof assembly. If areas if roofing are damaged despite protection, identify and mark damaged areas for temporary and permanent repair.

C. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

D. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075419

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Formed Products:

a. Formed low-slope roof sheet metal fabrications.
b. Formed wall sheet metal fabrications.
c. Formed equipment support flashing.

B. Related Requirements:

1. Section 072713 "Modified Bituminous Sheet Air Barriers" for flashing material provided as part of air and weather barrier systems.
2. Section 074646 "Fiber-Cement Siding" for flashing material provided as part of fiber-cement siding systems.
3. Section 075419 "Polyvinyl-Chloride (PVC) Roofing" for coordination with roofing system and accessories.
4. Section 077101 "Manufacturer Copings" for prefabricated manufactured copings.
5. Section 077273 "Vegetated Roofing Systems" for coordination with vegetated roofing system and accessories.
6. Section 079200 "Joint Sealants" for coordination with joint sealants.
7. Division 08 Section(s) for coordination with fenestration and door openings.
8. Section 092400 "Cement Plastering" for coordination of sheet metal flashing and trim with exterior cement plastering systems.

1.3 DEFINITIONS

A. ANSI: American National Standards Institute.

1. ANSI SPRI ES-1: Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems.

B. NRCA: National Roofing Contractors' Association.

1. NRCA Roofing Manual - 2017 Edition.

C. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1. SMACNA Architectural Sheet Metal Manual, 7th Edition.

1.4 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and location of penetrations to be flashed, and joints and seams in adjacent materials.

B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, noncorrosive, and warrantable (where part of another warrantied system) installation.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct at Project site.

1. Meet with Owner, Construction Manager, Architect, envelope consultant, sheet metal foreman and other adjoining trades and conduct a building envelope coordination meeting.
2. Review the following:

a. Construction schedule.
b. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
c. Special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
d. Approved sheet metal submittals and Shop Drawings.
e. Requirements for insurance and certificates if applicable.
f. Sheet metal flashing observation and repair procedures after flashing installation.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

B. Shop Drawings: Provide project-specific shop drawings for sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of roof-penetration flashing.
8. Include details of edge conditions, including crickets and counterflashings as applicable.
9. Include details of special conditions.
10. Include details of connections to adjoining work.
11. Detail formed flashing and trim at a scale of not less than 3 inches per foot.

C. Samples: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Sheet Metal Flashing: 12 inches long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches long and in required profile. Include fasteners and other exposed accessories.
3. Accessories and Miscellaneous Materials: Full-size Sample.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified fabricator.

B. Product Certificates: For each type of roof edge flashing that is SPRI ES-1 tested as part of roof edge securement.

C. Sample Warranty: For special warranty.

1.8 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sheet metal flashing, trim, and accessories to include in maintenance manuals.

1.9 QUALITY ASSURANCE

A. Fabricator Qualifications: An architectural sheet metal flashing and trim installation firm with not less than 10 years' experience with work similar in material, design, and extent to that indicated for this Project, and whose work has resulted in installations with a record of successful in-service performance.

1. For copings and roof edge flashings that are SPRI ES-1 tested, shop shall be listed as able to fabricate required details as tested and approved.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Description: Incorporate sheet metal flashing and trim into integrated exterior mockup per Section 014000 "Quality Requirements."
2. Testing shall be performed on mockups according to requirements specified in other Sections.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

C. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

1.11 WARRANTY

A. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight and prevent water intrusion into building interior.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. SPRI Wind Design Standard: Where part of roof edge securement, manufacture and install sheet metal flashing and trim tested according to SPRI ES-1 and capable of resisting the following design pressures:

1. Design Pressure: Per the 2016 California Building Code based upon maximum wind speed criteria indicated on the Structural Drawings.

D. Thermal Movements: Provide sheet metal flashing and trim that allows for thermal movements from ambient and surface temperature changes.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F material surfaces.

2.2 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.

B. Sheet Metal Selection: Provide sheet metals as indicated on Drawings and as specified. Where not indicated on Drawings, select sheet metal based on the performance requirements and limitations specified herein.

C. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required.

1. Exposed Coil-Coated Finishes:

a. Three-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
b. Color: Custom color to match Architect's sample.

2. Aluminum flashing shall be used in areas exposed to view, but shall not be used in any below-grade applications, nor shall it be used in any locations subject to contact with concrete surfaces.

D. Stainless-Steel Sheet: ASTM A 240, Type 304 (where concealed from view), Type 316 (where exposed to view), dead soft, fully annealed.

1. Exposed to View Finish: No. 4 (polished directional satin).
2. Concealed from View Finish: No. 2B or 2D.
3. Stainless steel sheet shall be used in concealed applications, in below-grade conditions, and in areas subject to contact with concrete.

E. Metallic-Coated Steel Sheet (Galvanized): Provide zinc-coated (galvanized) steel sheet: ASTM A 653, G90 coating designation.

1. Surface: Smooth, flat.
2. Galvanized sheet steel shall be limited to rooftop applications only, and that are not visible from any vantage point on the site, nor visible from any vantage point from within the building.
3. Galvanized sheet steel shall not be installed:
   a. In locations subject to contact with concrete.
   b. In locations subject to soil (i.e. vegetated/green roof systems).
   c. In any below-grade conditions.

2.3 UNDERLAYMENT MATERIALS

A. In Conjunction with Roofing: As specified in Section 075419 "Polyvinyl Chloride (PVC) Roofing."

B. In Conjunction with Waterproofing: As specified in other Division 07 waterproofing sections.

C. In Conjunction with Vegetated Roof: As specified in Section 077273 "Vegetated Roof Systems."

D. In Conjunction with Exterior Walls: As specified in Section 072713 "Modified Bituminous Sheet Air Barriers."

2.4 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal unless otherwise indicated.

B. Fasteners: Screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.

a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.

2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
3. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
4. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Hot-dip galvanized steel according to ASTM A 153 or ASTM F 2329 or Series 300 stainless steel. Coat with Elco Stalgard corrosion resistant protective coating or similar product.

C. Solder: Provide soldered metal flashing at all pan-type flashing applications and non-moving seams required to be watertight.

1. For Stainless Steel: ASTM B 32, Grade Sn60, with an acid flux of type recommended by stainless-steel sheet manufacturer.
2. For Zinc-Coated (Galvanized) Steel: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead.

D. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

E. Elastomeric Sealant: ASTM C 920, elastomeric polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

G. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

H. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.5 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.

1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
2. Obtain field measurements for accurate fit before shop fabrication.
3. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.

B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.

D. Sealant Joints: Where moveable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.

E. Fabricate cleats and attachment devices from same sheet metal material as accessory being anchored or from compatible, noncorrosive metal.

1. Thickness: Unless otherwise indicated, cleats shall be one gauge heavier that the materials being anchored.

a. Roof Edge Securement: For cleats that are part of a roof edge securement system, cleat thickness shall be determined in accordance with ANSI/SPRI performance requirement.

F. Fabricate cleats and attachment devices of sizes as recommended by SMACNA's "Architectural Sheet Metal Manual," but not less than thickness of metal being secured.

G. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use

H. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer**.**

I. Do not use graphite pencils to mark metal surfaces.

2.6 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Base Flashing: Fabricate from materials indicated on Drawings, or if not indicated, in compliance with “Sheet Metals” Article above:

1. Aluminum: Minimum 0.040 inch thick.
2. Stainless Steel: Minimum 0.019 inch thick.
3. Galvanized Steel: Minimum 0.028 inch thick.

B. Counter Flashing: Fabricate from materials indicated on Drawings, or if not indicated, in compliance with “Sheet Metals” Article above:

1. Aluminum: Minimum 0.032 inch thick.
2. Stainless Steel: Minimum 0.025 inch thick.
3. Galvanized Steel: Minimum 0.022 inch thick.

C. Flashing Receivers and Reglets: Fabricate from materials indicated on Drawings, or if not indicated, in compliance with “Sheet Metals” Article above:

1. Aluminum: Minimum 0.032 inch thick.
2. Stainless Steel: Minimum 0.019 inch thick.
3. Galvanized Steel: Minimum 0.022 thick.

D. Roof Penetration Flashing: Fabricate from materials indicated on Drawings, or if not indicated, in compliance with “Sheet Metals” Article above:

1. Stainless Steel: Minimum 0.019 inch thick.
2. Galvanized Steel: Minimum 0.028 thick.
3. Round Flashings Only: Coordinate with Section 075419 "Polyvinyl-Chloride (PVC) Roofing" for prefabricated PVC penetration flashings and for PVC-clad metal flashings.
4. Pitch pans are not acceptable for use as penetration flashings for this Project.

E. Roof Drain Flashing: Coordinate with Section 075419 "Polyvinyl-Chloride (PVC) Roofing."

2.7 WALL SHEET METAL FABRICATIONS

A. Opening Flashings: Fabricate head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch- high, end dams. Fabricate from the following materials:

1. Aluminum: 0.032 inch thick, where exposed to view and not in contact with concrete or soil.
2. Stainless Steel: Minimum 0.018 inch thick, where indicated, and where in contact with concrete or soil.

2.8 TRIM

A. Break Metal Enclosures: Fabricate from the following materials:

1. Aluminum: Minimum 0.050 inch thick.
2. Profile: As indicated on Drawings.

2.9 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from the following materials:

1. Stainless Steel: Minimum 0.019 inch thick.
2. Galvanized Steel: Minimum 0.028 thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.

1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

A. In Conjunction with Roofing: As specified in Section 075419 "Polyvinyl Chloride (PVC) Roofing."

B. In Conjunction with Waterproofing: As specified in other Division 07 waterproofing sections.

C. In Conjunction with Vegetated Roof: As specified in Section 077273 "Vegetated Roof Systems."

D. In Conjunction with Exterior Walls: As specified in Section 072713 "Modified Bituminous Sheet Air Barriers."

3.3 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
3. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
5. Install sealant tape where indicated.
6. Torch cutting of sheet metal flashing and trim is not permitted.
7. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.

1. Coat back side of uncoated aluminum and stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install high-temperature-rated self-adhering sheet underlayment.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.

D. Fasteners: Use fasteners of sizes that will penetrate metal framing not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as shown and as required for watertight construction.

1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
2. Prepare joints and apply sealants to comply with requirements in Division 7 Section "Joint Sealants."

G. Soldered Joints (At Sill Pan Metal Flashings and Where Indicated): Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches, except reduce pre-tinning where pre-tinned surface would show in completed Work.

1. Do not solder metallic-coated steel and aluminum sheet.
2. Do not use torches for soldering.
3. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
4. Stainless-Steel Soldering: Tin edges of uncoated sheets using solder recommended for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering. Comply with solder manufacturer's recommended methods for cleaning and neutralization.

3.4 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

B. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof.

3.5 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

3.6 MISCELLANEOUS FLASHING INSTALLATION

A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

B. Overhead-Piping Safety Pans: Suspend pans from structure above, independent of other overhead items such as equipment, piping, and conduit, unless otherwise indicated on Drawings. Pipe and install drain line to plumbing waste or drainage system.

3.7 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.8 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

D. Promptly clean all metal shavings, slivers, excess fasteners including rivet mandrils, from the roof surface to prevent puncture of roof membrane. Identify any holes and mark for permanent repair by roofing installer.

E. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, remove unused materials and clean finished surfaces. Maintain in a clean condition during construction.

F. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 076200

SECTION 077101 - MANUFACTURED COPINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes pre-engineered manufactured copings.

B. Related Requirements:

1. Section 054000 "Cold-Formed Metal Framing" for cold-formed metal blocking and curbs.
2. Section 075419 "Polyvinyl-Chloride (PVC) Roofing" for source limitations for manufactured copings provided under this Section and warranted by roofing system manufacturer.
3. Section 076200 "Sheet Metal Flashing and Trim" for custom- and site-fabricated sheet metal flashing and trim.
4. Section 077200 "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.
5. Section 079200 "Joint Sealants" for field-applied sealants between copings and adjacent materials.

C. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Construction Manager, Architect, envelope consultant, roofing-system testing and inspecting agency representative, roofing Installer, roofing-system manufacturer's representative, Installer, structural-support Installer, and installers whose work interfaces with or affects manufactured copings, including installers of roofing materials and accessories.
2. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
3. Review special roof details, roof drainage, and condition of other construction that will affect manufactured copings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Provide project-specific shop drawings for manufactured copings.

1. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work.
2. Include details for expansion and contraction; locations of expansion joints, including direction of expansion and contraction.
3. Indicate profile and pattern of seams and layout of fasteners, cleats, clips, and other attachments.
4. Detail termination points and assemblies, including fixed points.
5. Include details of special conditions.
6. If manufacturer’s coping system is not pre-engineered to meet performance requirements, provide shop drawings and analysis data stamped and signed by the qualified California-licensed professional engineer responsible for their preparation.

C. Samples for Initial Selection: For each type of roof specialty indicated with factory-applied color finishes.

D. Samples for Verification:

1. Include Samples of each type of roof specialty to verify finish and color selection, in manufacturer's standard sizes.
2. Include copings made from 12-inch lengths of full-size components in specified material, and including fasteners, cover joints, accessories, and attachments.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Product Certificates: For each type of manufactured coping that is SPRI ES-1 tested.

C. Product Test Reports: For copings, for tests performed by a qualified testing agency.

D. Sample Warranty: For manufacturer's special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing specialties to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of manufactured copings that have been used for similar applications with successful results, that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports. Manufacturer shall offer products meeting requirements that are and SPRI ES-1 tested to specified design pressure.

B. Installer Qualifications: A firm with not less than 10 years' experience installing manufactured copings similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and set quality standards for fabrication and installation.

1. Build mockup of typical roof edge as part of Integrated Exterior Mockup specified in Section 014000 "Quality Requirements"
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not store manufactured copings in contact with other materials that might cause staining, denting, or other surface damage. Store manufactured copings away from uncured concrete and masonry.

B. Protect strippable protective covering on manufactured copings from exposure to sunlight and high humidity, except to extent necessary for the period of roof-specialty installation.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify profiles and tolerances of roof-specialty substrates by field measurements before fabrication, and indicate measurements on Shop Drawings.

B. Coordination: Coordinate manufactured copings with flashing, trim, and construction of parapets, roof deck, roof and wall panels, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.9 WARRANTY

A. Roofing-System Warranty: Manufactured copings are included in warranty provisions in Section 075419 “Polyvinyl-Chloride (PVC) Roofing.”

B. Special Warranty on Painted Finishes: Manufacturer agrees to repair finish or replace manufactured copings that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

1. Sika Sanrafil, Inc. “Wall Grip Coping Plus.”

B. Source Limitations: Obtain manufactured copings approved by manufacturer providing roofing-system warranty specified in Section 075419 “Polyvinyl-Chloride (PVC) Roofing.”

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Manufactured copings shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

B. SPRI Wind Design Standard: Manufacture and install copings and roof-edge specialties tested according to SPRI ES-1 and capable of resisting the following design pressures:

1. Design Pressure: Per the 2016 California Building Code based upon maximum wind speed criteria indicated on the Structural Drawings.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.3 COPINGS

A. Metal Copings: Manufactured coping system consisting of metal coping cap in section lengths not exceeding 12 feet, concealed anchorage; with corner units, end cap units, and concealed splice plates with finish matching coping caps.

1. Formed Aluminum Sheet Coping Caps: Aluminum sheet, minimum 0.050 inch thick.

a. Surface: Smooth, flat finish.
b. Finish: Three-coat fluoropolymer.
c. Color: Custom color to match Architect's sample.

2. Corners: Factory mitered and sealed watertight.
3. Coping-Cap Attachment Method: Snap-on, fabricated from coping-cap material.

a. Snap-on Coping Anchor Plates: Concealed, galvanized-steel sheet, 12 inches wide, with integral cleats.

1) Thickness: As required to meet performance requirements, but no less than nominal 16 gauge.

2.4 MATERIALS

A. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.

B. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by manufacturer for type of use and finish indicated, finished as follows:

2.5 UNDERLAYMENT MATERIALS

A. At Roofing Locations: Extend roof membrane material up and over parapet wall to form underlayment below coping. Coordinate with Section 075419 “Polyvinyl-Chloride (PVC) Roofing.”

B. At Non-Roof Locations: As specified in Section 072713 "Modified Bituminous Sheet Air Barriers."

2.6 MISCELLANEOUS MATERIALS

A. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:

1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
2. Fasteners for Aluminum: Aluminum or Series 300 stainless steel.

B. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.

C. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type joints with limited movement.

D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.7 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Coil-Coated Aluminum Sheet Finishes:

1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

a. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1) Color: Custom color to match Architect’s sample.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Examine walls, roof edges, and parapets for suitable conditions for manufactured copings.

C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage where applicable, and securely anchored.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

A. At Roof Locations: Extend roof flashing membrane up and over parapet wall forming underlayment for coping. Comply with Section 075419 “Polyvinyl-Chloride (PVC) Roofing.”

B. At Non-Roof Locations: As specified in Section 072713 "Modified Bituminous Sheet Air Barriers."

3.3 INSTALLATION, GENERAL

A. General: Install manufactured copings according to manufacturer's written instructions. Anchor manufactured copings securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, underlayments, sealants, and other miscellaneous items as required to complete roof-specialty systems.

1. Install manufactured copings level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
2. Provide uniform, neat seams with minimum exposure of solder and sealant.
3. Install manufactured copings to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
4. Torch cutting of manufactured copings is not permitted.
5. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of uncoated aluminum manufactured copings with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of manufactured copings for waterproof performance.

C. Expansion Provisions: Allow for thermal expansion of exposed manufactured copings.

1. Space movement joints at a maximum of 12 feet with no joints within 18 inches of corners or intersections unless otherwise indicated on Drawings.
2. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.

D. Fastener Sizes: Use fasteners of sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance and complying with performance requriements.

E. Seal concealed joints with butyl sealant as required by roofing-specialty manufacturer.

F. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F.

3.4 COPING INSTALLATION

A. Install manufactured coping system in accordance with manufacturer’s written installation instructions.

B. Install cleated anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.

C. Anchor copings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

1. Interlock face and back leg drip edges of snap-on coping cap into cleated anchor plates anchored to substrate at manufacturer's required spacing that meets performance requirements.

3.5 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean off excess sealants.

C. Remove temporary protective coverings and strippable films as manufactured copings are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain manufactured copings in a clean condition during construction.

D. Replace manufactured copings that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077101

SECTION 077200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Roof hatches.
2. Roof hatch guards.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for metal vertical ladders.
2. Section 076000 "Sheet Metal Flashing and Trim" for shop- and field-fabricated metal flashing and counterflashing, and miscellaneous sheet metal trim and accessories.

1.3 COORDINATION

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.

B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of roof accessory.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Provide project-specific shop drawings for roof accessories.

1. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.

C. Samples: For each exposed product and for each color and texture specified, prepared on Samples of size to adequately show color.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:

1. Size and location of roof accessories specified in this Section.
2. Method of attaching roof accessories to roof or building structure.
3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.
4. Required clearances.

C. Sample Warranty: For manufacturer’s special warranties.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of roof accessories (including roof hatches) that have been used for similar applications with successful results, that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports.

B. Installer Qualifications: A firm with not less than 5 years' experience installing roof accessories similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

1.7 CLOSEOUT SUBMITTALS

A. Operations and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

1.8 WARRANTY

A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

B. Sheet Metal Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.

C. Roof hatches, associated accessories, and hatch guard railing systems shall meet or exceed OSHA and CALOSHA regulations.

2.2 ROOF HATCHES

A. Roof Hatches: Fabricate roof hatches with insulated double-wall lids and insulated wall frame with integral deck mounting flange and lid frame counterflashing. Fabricate with welded or mechanically fastened and sealed corner joints. Provide continuous weathertight perimeter gasketing and equip with corrosion-resistant or hot-dip galvanized hardware.

1. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

a. Bilco Company (The): Type S-50-TB Roof Hatch.

Or a comparable product by one of the following, subject to compliance with requirements herein and with Division 1 Section "Product Requirements:"

b. J.L. Industries, Inc.
c. Nystrom.

2. Type and Size: Single-leaf lid, 30 by 36 inches.
3. Performance characteristics:

    a. Cover and curb shall be thermally broken to prevent heat transfer between interior and exterior surfaces.
    b. Cover shall be reinforced to support a minimum live load of 40 psf with a maximum deflection of 1/150th of the span or 20 psf wind uplift.
    c. Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.
    d. Operation of the cover shall not be affected by temperature.
    e. Entire hatch shall be weather tight with fully welded corner joints on cover and curb.

4. Cover: Shall be 11 gauge aluminum with a 5" beaded flange with formed reinforcing members. Interior and exterior surfaces shall be thermally broken to minimize heat transfer and to resist condensation. Cover shall have a heavy extruded EPDM rubber gasket bonded to the cover interior to assure a continuous seal when compressed to the top surface of the curb.
5. Curb: Shall be 12" in height and of 11 gauge aluminum. Interior and exterior surfaces shall be thermally broken to minimize heat transfer and to resist condensation. The curb shall be formed with a 5-1/2" flange with 7/16" holes provided for securing to the roof deck. The curb shall be equipped with an integral metal capflashing of the same gauge and material as the curb, fully welded at the corners, that features the Bil-Clip® flashing system, including stamped tabs, 6" on center, to be bent inward to hold single ply roofing membrane securely in place.
6. Curb insulation: Shall be 3" thick polyisocyanurate with an R-value = 18.
7. Lifting mechanisms: Manufacturer shall provide compression spring operators enclosed in telescopic tubes to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and closing. The upper tube shall be the outer tube to prevent accumulation of moisture, grit, and debris inside the lower tube assembly. The lower tube shall interlock with a flanged support shoe welded to the curb assembly.
8. Hardware

    a. Heavy stainless steel pintle hinges shall be provided
    b. Cover shall be equipped with a spring latch with interior and exterior turn handles
    c. Roof hatch shall be equipped with interior and exterior padlock hasps.
    d. The latch strike shall be a stamped component bolted to the curb assembly.
    e. Cover shall automatically lock in the open position with a rigid hold open arm equipped with a 1" diameter red vinyl grip handle to permit easy release for closing.
    f. Compression spring tubes shall be an anti-corrosive composite material and all other hardware shall be type 316 stainless steel.
    g. Cover hardware shall be bolted into heavy gauge channel reinforcing welded to the underside of the cover and concealed within the insulation space.

9. Finish: Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

    a. Color and Gloss: Custom color to match Architect's sample.

B. Ladder Safety Post: Manufacturer's standard ladder safety post. Post to lock in place on full extension. Provide release mechanism to return post to closed position.

1. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

    a. Bilco Company (The): "LadderUP Safety Post."

    Or a comparable product by one of the following:

    b. J.L. Industries, Inc.
    c. Nystrom.
    d. Or Comparable Equal.

2.3 ROOF HATCH GUARDS

A. Safety Railing System: Manufacturer's standard complete system including rails, clamps, fasteners, safety barrier at railing opening, and all accessories required for a complete installation.

1. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

a. Bilco Company (The): "Bil-Guard Hatch Railing System."

Or a comparable product by one of the following:

b. J.L. Industries, Inc.
c. Nystrom.
d. Or Comparable Equal.

2. Height: 42" inches above finished roof deck.

2.4 METAL MATERIALS

A. Galvanized Steel Sheet: ASTM A 653, G90 coated.

1. Factory Prime Coating: Where field painting is indicated, apply pretreatment and white or light-colored, factory-applied, baked-on epoxy primer coat, with a minimum dry film thickness of 0.2 mil.

B. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792, AZ50 coated.

C. Prepainted, Metallic-Coated Steel Sheet: Steel sheet metallic coated by hot-dip process and prepainted by coil-coating process to comply with ASTM A 755.

1. Galvanized Steel Sheet: ASTM A 653, G90 coated.
2. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792, Class AZ50 coated.

D. Aluminum Sheet: ASTM B 209, alloy and temper recommended by manufacturer for type of use and finish.

E. Aluminum Extrusions and Tubes: ASTM B 221, alloy and temper recommended by manufacturer for type of use, mill finished.

F. Stainless-Steel Shapes or Sheet: ASTM A 240 or ASTM A 666, Type 304 or Type 316, No. 2D finish.

G. Steel Shapes: ASTM A 36, hot-dip galvanized to comply with ASTM A 123, unless otherwise indicated.

H. Steel Tube: ASTM A 500, round tube, baked-enamel finished.

I. Galvanized Steel Tube: ASTM A 500, round tube, hot-dip galvanized to comply with ASTM A 123.

J. Galvanized Steel Pipe: ASTM A 53.

2.5 MISCELLANEOUS MATERIALS

A. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

B. Glass-Fiber Board Insulation: ASTM C 726, thickness as indicated.

C. Polyisocyanurate Board Insulation: ASTM C 1289, thickness as indicated.

D. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

1. Slip Sheet: Rosin-sized paper, minimum 3 lb/100 sq. ft

E. Fasteners: Same metal as metals being fastened, or nonmagnetic stainless steel or other noncorrosive metal as recommended by roof accessory manufacturer. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners.

F. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, or PVC; or flat design of foam rubber, sponge neoprene, or cork.

G. Elastomeric Sealant: ASTM C 920, silicone sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

H. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, and heavy bodied for hooked-type expansion joints with limited movement.

I. Roofing Cement: ASTM D 4586, nonasbestos, fibrated asphalt cement designed for trowel application or other adhesive compatible with roofing system.

2.6 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of Work.

B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored and is ready to receive roof accessories.

C. Verify dimensions of roof openings for roof accessories.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install roof accessories according to manufacturer's written instructions.

1. Anchor roof accessories securely in place so they are capable of withstanding indicated loads.
2. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
3. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

B. Install roof accessories to fit substrates and to result in watertight performance.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of uncoated aluminum or stainless-steel roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing exposed-to-view components of roof accessories directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene underlayment.
3. Bed flanges in thick coat of asphalt roofing cement where required by roof accessory manufacturers for waterproof performance.

D. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.

E. Prefabricated Roof Curb Installation: Install each roof curb so top surface is level.

F. Equipment Support Installation: Install equipment supports to stop surfaces are level with each other.

G. Roof Hatch Installation:

1. Install roof hatch so top surface of hatch curb is level.
2. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
3. Attach safety railing system to roof hatch curb.
4. Attach ladder safety post according to manufacturer's written instructions.

H. Seal joints with elastomeric or butyl sealant as required by manufacturer of roof accessories.

3.3 REPAIR AND CLEANING.

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A 780.

B. Touch up factory-finished surfaces per manufacturer's written instructions.

C. Clean exposed surfaces according to manufacturer's written instructions.

D. Clean off excess sealants.

E. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077200

SECTION 077273 - VEGETATED ROOF SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes vegetated roof system, including, but not limited to, the following:

1. Vegetation, including monitoring the installation of the vegetative cover.
2. Growth medium system.
3. Plaza deck pavers.
4. Drainage panels.
5. Insulation [I-7].
6. Hot fluid-applied waterproofing system [WP-2GR], including membrane, flashings, sealants, and accessories.
7. Substrate preparation.
8. Additional accessories, whether indicated or not, for a complete, watertight, vegetated roof system.

B. Related Requirements:

1. Section 033000 "Cast-In-Place Concrete" for coordination with concrete surface finishing, tolerances, and other characteristics impacting vegetated roof system membrane.
2. Section 071413 "Hot Fluid-Applied Rubberized Asphalt Waterproofing" for hot fluid-applied waterproofing [WP-2] to the extent not provided under this Section.
3. Section 071616 "Cold Fluid-Applied Waterproofing" for transition of hot fluid-applied waterproofing [WP-2GR] below grade to composite liquid polyurethane U.V.-stable fluid-applied waterproofing [WP-4] above grade.
4. Section 072713 "Modified Bituminous Sheet Air Barriers" for coordination and interface with adjacent air and weather barriers.
5. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.
6. Section 129300 "Site Furnishings" for exterior unit planters.

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM).

1. ASTM C 920 - Standard Specification for Elastomeric Joint Sealants
2. ASTM D 4258 - Standard Practice for Surface Cleaning Concrete for Coating
3. ASTM D 4263 - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
4. ASTM D 4716 - Standard Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head
5. ASTM E 2397 – Standard Practice for Determination of Dead Loads and Live Loads Associated with Vegetative (Green) Roof Systems
6. ASTM E 2398 - Standard Test Method for Water Capture and Media Retention of Geocomposite Drain Layers for Vegetative (Green) Roof Systems
7. ASTM E 2399 - Standard Test Method for Maximum Media Density for Dead Load Analysis of Vegetative (Green) Roof Systems
8. ASTM E 2400 - Standard Guide for Selection, Installation, and Maintenance of Plants for Green Roof Systems
9. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials
10. ASTM E 96/E 96M - Standard Test Methods for Water Vapor Transmission of Materials
11. CAN/CGSB-37.50-M89: Hot-Applied, Rubberized Asphalt for Roofing and Waterproofing.

B. Underwriters Laboratories (UL) Class A.

1.4 DEFINITIONS

A. Vegetated Roof; Green Roof; Roof Garden: An area of planting/landscaping, built up on a waterproofed substrate at any level that is separated from the natural ground by a man-made structure.

1. Semi-Intensive and Intensive Vegetated Roof: Deeper landscape built using an assembly consisting of 6 inches or more of engineered growing media or more, with a wider variety of plant species including shrubs and trees.

B. Vegetated Roof Assembly; Green Roof Assembly; Roof Garden Assembly: Multi-layered landscaped assembly composed of single-media system, designed to grow plants and to retain and retard rainwater runoff from the roof.

1. Semi-Intensive and Intensive Vegetated Roof Assemblies consist of the following fully integrated living and manufactured components:

a. Waterproofing membrane.
b. Electronic leak detection.
c. Root barrier protection.
d. Technical seam tapes.
e. Drainage course.
f. Horizontal insulation.
g. Air layer.
h. Moisture retention mat.
i. Ballast reducing scrim sheet.
j. Drain inspection box.
k. Drainage/water retention component
l. Filter fabric.
m. Engineered growing media.
n. Vegetation.
o. Edging restraint.
p. Pre-cast concrete pavers.
q. Erosion control netting.
r. Irrigation.

C. Captured Water: Water that is retained in the drainage layer of a vegetated roof assembly after new water additions have ceased and that cannot escape the roof except through evaporation or plant transpiration.

D. Steep Slope Green Roof: Defined as a slope exceeding 3:12 pitch.

E. “C” Factor: The runoff coefficient used in the Rational Method, where “C” is the ratio of runoff to precipitation received over a given area.

F. Curve Number (CN): A number used to predict direct runoff or infiltration from rainfall, developed by USDA Natural Resource Conservation Service, taking into account a site’s soil type, land use, site conditions, drainage patterns, and pervious and impervious coverage.

G. Planted Area; Vegetated Area: Areas to be planted.

H. Vegetation-Free Zone: Areas without plantings.

I. Plant; Plants; Plant Material: Vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.

J. Alive: Displaying horticultural viability consisting of vigorous, hardy, and sustainable growth characteristics.

K. Retained Water: Water that is held for a period of hours or days but would eventually drain out given enough time in the absence of evaporation or plant transpiration.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Construction Manager, Architect, envelope consultant, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review the following:

a. Coordinate: Requirements and procedures related to roof deck and roofing system construction, including curing and surface preparation.
b. Vegetated Roof Assembly: Review methods and procedures, including Manufacturer’s written installation instructions.
c. Construction Schedule: Review and confirm availability of products, Subcontractor personnel, equipment, and facilities.
d. Conformance: Review roofing membrane type and vegetated roof assembly criteria.
e. Structural Load: Review limitations of roof deck, identifying loading areas for storage. Obtain structural report from Consultant certifying dead load weight restrictions for entire assembly.
f. Roof Details: Review flashing, drains, penetrations, equipment curbs, and other conditions.
g. Regulations: Review, including necessary insurance and/or certificates.
h. Safety: Review requirements, including Fall Protection requirements.
i. Quality Control: Review procedures and policy.
j. EFVM: Obtain report certifying roof is watertight.
k. Coordinate: related work specified in other Sections.
l. Inspection: Review Manufacturer’s procedure for warranty.
m. On-site traffic: Review limits by other trades on vegetated roof assembly and procedures for compensation due to damage.
n. Meeting minutes: Taken by representative of Consultant and distributed to all parties within 24 hours of meeting date.
o. Photographic records: Taken by Contractor prior to commencement of Work.

3. Contractor shall prepare minutes of preinstallation conference and distribute to participants.

1.6 COORDINATION

A. Coordinate vegetated roof systems installation with air/weather barriers, flashing, trim, wall and glazing construction, and other adjoining work to provide a watertight, airtight, secure, and noncorrosive installation.

1.7 ACTION SUBMITTALS

A. General: Transmit all action and informational submittal items together in one single complete submittal package for review.

B. Product Data: For each component of the vegetated roof assembly.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include material descriptions for each growing medium.

C. Shop Drawings: Provide project-specific shop drawings for each vegetated roof assembly. Include the following:

1. Include plans, sections, slopes, and drain locations.
2. Indicate dimensions, weights, and loads.
3. Detail field assembly of components, depth of growing media, and attachments to other work.
4. Indicate walkway pavers, geofoam fill, locations of irrigation, coordination with lighting and accessories.

D. Samples for Verification: For each of the following components of vegetated roof assembly, in 12 by 12 inch samples size unless otherwise indicated:

1. Insulation.
2. Separation layer.
3. Waterproof membrane and flashings.
4. Root barrier: 12 inch x 12 inch.
5. Drainage course: 12 inch x 12 inch.
6. Moisture retention mat: 12 inch x 12 inch].
7. Drainage/water retention component: 12 inch x 12 inch.
8. Filter fabric: 12 inch x 12 inch.
9. Growing media: 1-quart volume of each growing media, in sealed plastic bags labeled with content and source. Each Sample shall be typical of the lots of growing media to be furnished. Provide an accurate representation of texture and composition.

1.8 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer**.**

B. Product Certificates: For each type of manufactured product.

1. Manufacturer's certified analysis of standard products.
2. Analysis of other materials by a recognized laboratory, according to methods established by the Association of Official Analytical Chemists, where applicable.

C. Product Test Reports: For complete analysis of each growing medium, for tests performed by manufacturer and witnessed by a qualified testing agency or by a qualified testing agency.

D. Certifications for Waterproofing:

1. Certification from an approved independent testing laboratory experienced in testing waterproofing membranes for applicable ASTM procedures.
2. Certification showing full time quality control of production facilities responsible for the manufacture of the waterproofing membrane and that each batch of material is tested to ensure conformance with the manufacturer’s published physical properties.
3. The plant manufacturing the material shall have ISO 9001-2000 approval as evidenced by a copy of the official certificate.
4. Evidence that the roof membrane assembly is currently Class A listed with Underwriters Laboratories.

E. Letter from manufacturer and installer indicating acceptance of substrate prior to installation of waterproofing system.

F. Stormwater Performance Data: Predicted performance of the specific green roof assembly for the project shall be provided and include:

1. Composite Curve Number (CN)
2. Composite C-factor
3. Calculations shall be based on actual testing of suppliers green roof components to be used for the project including but not limited to the regionally specific growing media formulation and water retention/drainage materials.
4. Calculations shall account for vegetated and un-vegetated portions of the roof as well as local climatic conditions including rainfall depth, intensity, duration, and timing.

G. Field quality-control reports.

H. Sample Warranty: For special warranties.

1.9 CLOSEOUT SUBMITTALS

A. Maintenance Data: For vegetated roof assembly and plants, including a recommended maintenance plan with procedures for inspection and care during a calendar year. Submit before start of required warranty and maintenance periods.

B. Continuing Maintenance Proposal: From vegetated roof assembly Installer and approved by roofing-membrane manufacturer to Owner, in the form of a standard one-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1.10 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 20 years' experience regularly engaged in the production and sales of hot fluid-applied rubberized asphalt waterproofing and vegetated roof systems that have been used for similar applications with successful results, that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports. Manufacturer shall have factory-authorized service representatives who are available for consultation, periodic Project-site observations, and on-site assistance.

1. Manufacturer of vegetated roof system shall be same manufacturer as specified for Section 071413 "Hot Fluid-Applied Rubberized Asphalt Waterproofing" and for Section 071416 "Cold Fluid-Applied Waterproofing."

B. Installer Qualifications: A firm with not less than 10 years' experience installing vegetated roof assemblies similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section. Installer shall be licensed and eligible to receive manufacturer's special warranty. Also comply with installer qualifications as specified in Section 071413 "Hot Fluid-Applied Rubberized Asphalt Waterproofing" for waterproofing to the extent not provided under this Section.

1. Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when vegetated roof assembly work is in progress.

C. Mock-Up: Build mock-ups to set quality standards for materials and executions.

1. Build mock-up of vegetated roof assembly and associated components and accessories.
2. Size: 100 sq. ft. to demonstrate assembly installation and standard of workmanship.
3. Subject to compliance with requirements, approved mock-ups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Product Handling: Deliver and store products in original packaging with Manufacturer's labels and materials list intact and signed off, elevated from ground and protected from environmental damage within designated weather protected areas. Avoid storage of products on site to prevent contamination.

B. Apply waterproofing within the range of ambient and substrate temperatures recommended by a waterproofing manufacturer.

1. Protect substrates from environmental conditions that affect waterproofing performance.
2. Do no apply waterproofing to a wet substrate or during snow, rain, fog, or mist.
3. Ensure waterproofing materials are cured before covering with other materials.

C. Vegetation Handling: Install vegetation immediately upon delivery to site.

D. Installation:

1. Vegetation: According to optimal conditions, conducive to plant establishment and survival based upon local hardiness zone as defined by USDA.
2. All other components of vegetated roof assembly: At any time, adequate protection should be provided to prevent damage and erosion

E. Foot Traffic: Prohibited on vegetated roof assembly during vegetation establishment period and thereafter except for vegetated roof maintenance purposes.

1.12 FIELD CONDITIONS

A. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

B. Do not install materials that are wet, moisture damage, and/or mold damaged.

1.13 WARRANTY

A. Special Warranty for Vegetated Roof System: Manufacturer’s standard or customized form, without monetary limitation, in which manufacturer and installer agree to repair or replace components of vegetated roof system that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, defective waterproofing membrane, failure of the waterproof membrane to stop the passage of water, ponding water or prolonged wetness of growing medium caused as a result of failure of the assembly to properly drain.
2. Warranty Period: 20 years from date of Substantial Completion.

B. Special Warranty for Plant Growth: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

1. Foliage Cover: Planted materials shall grow to achieve and maintain at least 80 percent foliage cover over planting area commencing 24 months after planting, through the duration of this warranty.
2. Failures include, but are not limited to, death and unsatisfactory growth except for defects resulting from abuse, lack of adequate maintenance, neglect by Owner, or incidents that are beyond Contractor's control.
3. Warranty Period: From date of Substantial Completion as follows:

    a. Trees and Shrubs: Five years.
    b. Ground Covers, Perennials, Vines, and Ornamental Grasses: Five years.

4. Include the following remedial actions as a minimum:

    a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
    b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
    c. A limit of one replacement of each plant will be required except for losses or replacements due to failure to comply with requirements.

5. Provide extended warranty for period equal to original warranty period, for replaced plant material.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide vegetated roof system by the following:

1. Membrane Assembly: TREMproof 6100 Hot Fluid-Applied Waterproofing by Tremco Inc., www.tremcosealants.com
2. Intensive Vegetated Roof Assembly: VR MAX + Vegetated Roof Assembly System by Tremco Inc., www.tremcosealants.com with depth of system as indicated on Drawings.

B. Source Limitations: Obtain vegetated roof assembly components, growing medium, walkway pavers and setting bed or supports, geofoam fill and separation geotextile, and accessories from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Waterproofing Membrane: Waterproofing system shall be capable of performing as a continuous watertight installation and as a moisture drainage plane transitioned to adjacent flashings and discharging water to the building exterior. Waterproofing shall accommodate normal substrate movement, construction material transitions, opening transitions, penetrations, and perimeter conditions without resultant moisture deterioration.

1. Compatibility: Provide waterproofing system materials that are compatible with one another and with adjacent materials under conditions of service and application required, as demonstrated by waterproofing manufacturer based on testing and field experience.

B. Vegetated Roof Assembly: Provide vegetated roof assembly that will support vegetation, reaching an average coverage of not less than 85 percent coverage of the growing media within 24 months of Substantial Completion.

C. Water Capacity: Provide vegetated roof assembly with water retention capacity of a minimum of 4.5 gal/cu. ft. of water. Calculations include the combined water retention capacity of growing media and drainage panel. For growing media, the water retention capacity is calculated by using the difference between dry and saturated weight as per ASTM E 2399. For the drainage panel, the water retention capacity is found when measured in accordance with ASTM E 2398.

D. Drainage: Provide vegetated roof assembly with rainfall drainage capacity not less than 5 in./hr. Rainfall drainage capacity based on saturated hydraulic conductivity of growing media in accordance with ASTM E 2399.

E. Structural Design Load: Provide vegetated roof assembly with superimposed dead load not exceeding load indicated on Drawings. Calculations must be based on saturated weight of all components of vegetated roof assembly and maximum media density at saturation of growing media in accordance with ASTM E 2399.

F. Engineered growing Media: Provide engineered growing media that meets the following characteristics:

1. Depth: As indicated on Drawings.
2. Bulk Density: Not more than 75 lb./cu. ft. Calculations must be based on maximum media density at saturation of growing media in accordance with ASTM E 2399.
3. Dry Weight: Not less than 20 lb./cu. ft. Calculations must be based on dry weight of growing media in accordance with ASTM E 2399.
4. Source Material: Recycled products.
5. Source Location: Locally to project site, within 500 mile radius.

G. Vegetation:

1. Source Location: Locally to project site, within 500 mile radius.
2. Sustainability: Components shall be made from 100% recycled materials and sourced within 500 mile radius of project site when possible.

2.3 WATERPROOFING MEMBRANE

A. Hot Fluid-Applied Rubberized Asphalt Waterproofing: Single component, 100 percent solids; hot fluid-applied, rubberized asphalt formulated for application of not less than 215 mils wet, applied in two applications in conjunction with an interlayer of reinforcing fabric.

1. Basis of Design Product: Subject to compliance with requirements, provide waterproofing membrane by the following:

a. Tremco, Inc., TREMproof 6100.

2. Vapor Permeance, ASTM E 96: Maximum 0.03 perms.
3. VOC Content: 0 g/L.

2.4 AUXILIARY MATERIALS

A. General: Auxiliary materials as described in manufacturer's written installation instructions, recommended to produce complete waterproofing system meeting performance requirements, and compatible with waterproofing material and adjacent materials.

B. Substrate Patching Material: Waterproofing manufacturer's standard trowel-grade filler material.

C. Primer: Tremco approved primer meeting VOC limitations and recommended for substrate by waterproofing manufacturer.

D. Reinforcing Fabric: Waterproofing manufacturer's standard spun-bonded polyester fabric

1. Basis of Design Product: Tremco, Inc., Reinforcing Fabric.

E. Elastomeric Sheet: Thermoset neoprene rubber sheet not less than 60 mil.

1. Basis of Design Product: Tremco, Inc., Elastomeric Sheeting.

F. Elastomeric Detail Sheet: Blended thermoset elastomeric sheet reinforced with polyester woven scrim.

1. Basis of Design Product: Tremco, Inc., TRA Elastomeric Sheeting.

G. Composite Elastomeric Sheet: Waterproofing manufacturer's standard consisting of a SEBS rubber faced on two sides with absorbent non-woven felt.

1. Basis of Design Product: Tremco, Inc., DualFlex.

H. Metal Termination Bars: Waterproofing manufacturer's standard aluminum or stainless steel termination bar, with stainless steel fasteners.

I. Joint Sealant: ASTM C 920, single-component urethane, approved by waterproofing manufacturer for adhesion and compatibility with waterproofing and accessories.

J. Membrane Leak-Detection System: Conductor cable, placed on top of membrane, delivering direct current tension to membrane surface, enabling inspection and isolation of points of moisture infiltration through membrane to conductive substrate under membrane.

1. Measurement Grid: Highly conductive stainless steel wire measurement grid located under membrane and above non-conductive membrane substrate, connected through contact plate and cable to connection box accepting low-voltage charge from portable pulse generator. Include conductor cable, measurement grid, connection box, and accessories for a complete membrane leak-detection system.

2.5 VEGETATED ROOF ASSEMBLY COMPONENTS

A. Root Barrier: Heavy-duty 4-ply laminate polymer film, re-inforced with a layer of high strength cord grid, flame-retardant. Use with Manufacturer’s recommended technical seam tape.

1. Basis of Design Product: Tremco, Inc., VR RootBloc 10.
2. Physical Properties:

a. Thickness: 10 mil.

3. Mechanical Properties:

a. Elongation at break, ASTM D 7003: 500%.
b. 1” Tensile Strength, ASTM D 7003: 60 lbf/in.
c. Grab Tensile Strength , ASTM D 7004: 80 lbf.
d. Trapezoid Tear , ASTM D 4533: 52 lbf.
e. Hydrostatic Resistance, ASTM D 751: 74 psi.
f. Mullen Burst, ASTM D 751: 90 psi.

4. Flame Spread Index – Class “A”, ASTM E 84: 5.

B. Root Barrier: Heavy-duty blended linear polyethylene membrane, infused with carbon black additive for UV resistance. Use with Manufacturer's recommended 4-inch technical seam tape. Heat welding is an option.

1. Basis of Design Product: Tremco, Inc., VR RootBloc 40.
2. Physical Properties:

    a. Thickness: 40 mil.

3. Mechanical Properties:

    a. Elongation at break, ASTM D 6693: 800%.
    b. 1" Tensile Strength, ASTM D 6693: 154 lbf.
    c. Tear Resistance, ASTM D 1004: 22 lbf.
    d. Puncture Resistance, ASTM D 4833: 60 lbf.
    e. Mullen Burst, ASTM D 751: 220 psi.

C. Prefabricated Drainage Course: Composite drainage system consisting of a three-dimensional, crush-proof drainage core with filter fabric bonded to one side.

1. Basis of Design Product: Tremco, Inc., VR TremDrain 22F.
2. Physical Properties:

    a. Thickness: 0.275 in.

3. Drainage Core Properties:

    a. Tensile Strength: 50 lb/in.
    b. Transmissivity, ASTM D 4716: 14.50 gal/min/ft.

4. Fabric Properties:

    a. Grab Tensile: 90 lb.
    b. Water Flow Rate, ASTM D 4491: 150 gpm/sq. ft..
    c. Apparent Opening Size (AOS), ASTM D 4751: 50 US Sieve.
    d. UV Resistance, ASTM D 4355: 70%.

D. Prefabricated Drainage Course: Composite drainage system consisting of a three-dimensional, polypropylene dimple-type drainage sheet with filter fabric bonded to one side.

1. Basis of Design Product: Tremco, Inc., VR TremDrain 40FD.
2. Physical Properties:

    a. Thickness: 0.47 in.

3. Drainage Core Properties:

    a. Compressive Strength: 15,000 psf.
    b. Recycled Content: 77%.

4. Fabric Properties:

    a. Grab Tensile: 90 lb.
    b. Water Flow Rate, ASTM D 4491: 150 gpm/sq. ft.
    c. Apparent Opening Size (AOS), ASTM D 4751: 50 US Sieve.
    d. UV Resistance, ASTM D 4355: 70%.

E. Horizontal Insulation [I-7]: Extruded-polystyrene board insulation, ASTM C 578, of type and minimum compressive strength indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84, unfaced; fabricated with shiplap or channel edges and with side facing Protection sheet having grooved drainage channels.

1. Type and Compressive Strength: As indicated on Drawings, but no less than Type VII, 60 psi.
2. Thickness: As indicated on Drawings.
3. R value: 5 per inch.
4. Product shall be free of CFC's.

F. Air Layer: Required air space over styrofoam insulation, consisting of crush-proof high-density polypropylene core, bonded with non-woven filter fabric.

1. Basis of Design Product: Tremco, Inc., VR TremDrain 22F.
2. Physical Properties:

    a. Thickness: 0.275 in.

3. Drainage Core Properties:

    a. Tensile Strength: 50 lb/in.
    b. Transmissivity, ASTM D 4716: 14.50 gal/min/ft.

4. Fabric Properties:

    a. Grab Tensile: 90 lb.
    b. Water Flow Rate, ASTM D 4491: 150 gpm/sq. ft.
    c. Apparent Opening Size (AOS), ASTM D 4751: 50 US Sieve.
    d. UV Resistance, ASTM D 4355: 70%.

G. Moisture Retention Mat: Non-woven synthetic fiber mat capable of retaining additional moisture for potential use by vegetation.

1. Basis of Design Product: Tremco, Inc., VR MoistureMat.
2. Physical Properties:

    a. Thickness: 0.395 in.
    b. Dry Weight: 50 oz./sq. yd.
    c. Saturated Weight: 434 oz./sq. yd.

3. Mechanical Properties:

    a. Maximum Tensile Strength: Longitudinal: 100%, Lateral: 140%.
    b. Maximum Tensile Elongation: Longitudinal: 8 kN/m, Lateral: 4 kN/m.

4. Hydraulic Properties:

    a. Water Retention Capacity: 0.22 gal/sq. ft.

H. Drainage/Water Retention Component: High-density polypropylene, molded into a three-dimensional panel with positive-locking clips, drainage channels, and water retention reservoirs to form an integrated water retention and drainage system, consisting of 100% recycled content. Option to be filled with lightweight aggregate.

1. Basis of Design Product: Tremco Inc., VR HydraPanel 1.25.
2. Physical Properties:
3. Thickness: 1.25 in.

    a. Panel Dimensions: 2 ft x 2 ft.
    b. Weight, dry: 0.6 lb./sq. ft.
    c. Weight, with water: 1.93 lb./sq. ft.

4. Hydraulic Properties:

    a. Water Retention Capacity: 0.165 gal/sq. ft..

I. Drainage/Water Retention Component: High-density polypropylene, molded into a three-dimensional panel with positive-locking clips, drainage channels, and water retention reservoirs to form an integrated water retention and drainage system, consisting of 100% recycled content. Option to be filled with lightweight aggregate.

1. Basis of Design Product: Tremco Inc., VR HydraPanel 2.
2. Physical Properties:

    a. Thickness: 2.125 in.
    b. Panel Dimensions: 2 ft x 2 ft.
    c. Weight, dry: 0.86 lb./sq. ft.
    d. Weight, with water: 3.79 lb./sq. ft.

3. Mechanical Properties:

    a. Compressive Strength, ASTM A 370-11: 7,782 psf.

4. Hydraulic Properties:

    a. Water Retention Capacity: 0.352 gal/sq. ft. (14.35 L/sq. m).

J. Lightweight Aggregate: Expanded lightweight aggregate for use as fill material for drainage/water retention component as required.

1. Physical Properties:

    a. Size: 5/16 - 3/8 in expanded, lightweight aggregate.

K. Filter Fabric: Highly permeable non-woven polypropylene filter fabric, needle punched geo-textile manufactured, used to contain soil particles within soil profile at termination edges.

1. Basis of Design Product: Tremco Inc., VR Filter Fabric, VR Filter Fabric 1, VR Filter Fabric 2.
2. Physical Properties:

    a. Thickness: 45 mil.
    b. Weight: 3.2 oz./sq. yd.

3. Mechanical Properties:

    a. Grab Elongation, ASTM D 4632: 50%.
    b. Grab Tensile Strength, ASTM D 4632: 80 lbf.
    c. Trapezoid Tear, ASTM D 4533: 30 lbf
    d. Puncture Strength, ASTM D 6241: 210 lbf.

4. Endurance Properties:

    a. UV Stability, ASTM D 4355: 70%.

5. Hydraulic Properties:

    a. Permittivity, ASTM D 4491: 2.2 sec^-1.
    b. Water Flow Rate, ASTM D 4491: 160 gpm/sq. ft.
    c. Apparent Opening Size (AOS), ASTM D 4751: 70 US Sieve.

L. Technical Seam Tape: Self-adhered, waterproof membrane with acrylic pressure sensitive adhesive.

1. Basis of Design Product: Tremco Inc., VR TecTape 2.
2. Physical Properties:

    a. Thickness: 9.9 mil.

3. Mechanical Properties:

    a. Nail Sealability, ASTM E 331/547 (per AAMA 711-07, Annex 1): Pass both before and after thermal cycling.

M. Edging Restraint: Manufacturer's standard L-shaped edging with top lip, formed from extruded aluminum. Solid at growing layer to prevent rooting and plant growth through the edging. Perforated at drainage course level to allow for free drainage. Use with Manufacturer's edge connectors, edge corners, and edge leveling strips.

1. Basis of Design: Tremco, Inc., VR EdgeGuard.
2. Physical Properties:

    a. Thickness: 80 mil.
    b. Height: As indicated on Drawings.
    c. Flange Length: 4 in .
    d. Length: 8 ft.
    e. Lip: 3/8 in..
    f. Perforations, diameter: 3/4 in.

N. Drain Inspection Box: Manufacturer's standard drain inspection box formed from aluminum, with lockable lid and perforated at drainage course level.

1. Basis of Design: Tremco Inc, VR DrainGuard.
2. Physical Properties:

    a. Thickness: 60 mil.
    b. Dimensions: 15 in x 15 in.
    c. Height: As indicated on Drawings.
    d. Perforations, diameter: 3/4 inch.

O. Erosion Control Netting: Polypropylene quadrangular mesh netting for establishment of seed and plugs.

1. Basis of Design: Tremco Inc., VR TerraHold.
2. Physical Properties:

    a. Thickness: 0.32 in.
    b. Mesh Shape: Quadrangular.
    c. Unit Weight: 0.033 oz./sq. ft.

3. Mechanical Properties:

    a. Tensile Strength, MD: 0.145 psi.
    b. Tensile Strength, TD: 0.116 psi.

2.6 VEGETATED ROOF GROWING MEDIA

A. Growing Media: Vegetated roof assembly manufacturer's lightweight, biologically populated, engineered growing media mixture incorporating regional inorganic and organic materials that will support the vigorous growth of a wide variety of vegetation growth and retain and remediate storm water run-off.

1. Basis of Design: Tremco, Inc., VR HydraMix Intensive.
2. Depth: As indicated on Drawings.
3. Semi-Intensive and Intensive Blend Maximum Media Density, ASTM E 2399:

    a. Initial Dry-Weight Media Density: Minimum 20 lb/cu. ft.
    b. Maximum Saturated Media Density : Maximum 70 lb/cu. ft.

4. Water/Air Management, ASTM E2399:

    a. Maximum Water Holding Capacity: 60 percent, minimum.
    b. Air-Filled Porosity at Maximum Water Capacity: 10 percent, minimum.
    c. Total Pore Space: 70 percent, minimum.

5. Water Permeability, ASTM E 2399:

    a. Hydraulic Conductivity: Minimum 5 in./hr.

6. Chemical Properties:

    a. Growing Media pH: Value within 6.0 - 7.5.
    b. Macro- and micro- nutrients: Incorporate in initial proportions as required to support specified planting.

7. Organic Matter Content: as required to meet plant requirements.

B. Growing Media: Vegetated roof assembly manufacturer's lightweight, biologically populated, engineered growing media mixture incorporating regional inorganic and organic materials that will support the vigorous growth of a wide variety of vegetation growth and retain and remediate storm water run-off.

1. Basis of Design: Tremco, Inc., VR PlanterMix.
2. Depth: As per plans and specifications.
3. Semi-Intensive and Intensive Blend Maximum Media Density, ASTM E 2399:

    a. Initial Dry-Weight Media Density: Minimum 25 lb/cu. ft.
    b. Maximum Saturated Media Density : Maximum 75 lb/cu. ft.

4. Water/Air Management, ASTM E2399:

    a. Maximum Water Holding Capacity: 35 percent, minimum.
    b. Air-Filled Porosity at Maximum Water Capacity: 10 percent, minimum.
    c. Total Pore Space: 70 percent, minimum.

5. Water Permeability, ASTM E 2399:

    a. Hydraulic Conductivity: Minimum 5 in./hr.

6. Chemical Properties:

    a. Growing Media pH: Value within 6.0 - 7.5.
    b. Macro- and micro- nutrients: Incorporate in initial proportions as required to support specified planting.

7. Organic Matter Content: as required to meet plant requirements.

2.7 VEGETATED ROOF PLANTING MATERIALS

A. Planting Materials, General: Provide plant materials of types indicated.

B. Semi-Intensive and Intensive Planting Materials:

1. Seed: A minimum of 90% purity, in dry form and without litter. Seed mix to be provided via injection into Blower Truck’s Supplemental Injection System.

    a. Spread Rate: 5 lb/1000 sq. ft.

2. Perennial Plugs: Healthy, vigorous, well-rooted specimens, provided in 50-plug tray with well-established rooting.

    a. Depth: 2 in minimum.
    b. Spacing: 6 in on center.

3. Perennial Pots: Healthy, vigorous, well-rooted specimens, with well-established rooting. Root bound plants will not be accepted.

   a. Depth: 3.5 in, minimum.
   b. Spacing: 12 in on center.

4. Shrubs, Trees: As per plans and specifications.

2.8 VEGETATION-FREE ZONE MATERIALS

A. Walkway Roof Pavers: pre-cast concrete pavers with pedestals.

1. Basis of Design: Armtec, Pedslab.
2. Physical Properties:

   a. Size: 24 in x 24 in.
   b. Thickness: 2-1/4 in.
   c. Weight: 11 lb/sq. ft., minimum.
   d. Colors and Textures: natural color with shot blast finish.

3. Mechanical Properties:

   a. Compressive Strength: 8000 psi, minimum.
   b. Absorption: 5%, maximum.
   c. Freeze-thaw Resistance: 1.0% loss in weight after 40 cycles, maximum.

4. Paver Supports: Paver manufacturer's standard SBR rubber, high-density polyethylene, or polyurethane paver support assembly, including adjustable pedestals, shims, and spacer tabs for joint spacing of 1/8 to 3/16 inch.

B. Aggregate Ballast: ASTM D 1863, No. 6 or No. 67, clean, dry, opaque, water-worn gravel, free of sharp edges.

1. Size: ASTM D 448, Size 4, 3/4 to 1-1/2 in.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Surface Condition for Waterproofing: Before applying waterproofing materials, examine substrate and conditions to ensure substrates are fully cured, smooth, clean, dry, and free from high spots, depressions, loose and foreign particles and other deterrents to adhesion, and conditions comply with manufacturer's written recommendations.

1. Verify concrete and masonry surfaces are visibly dry, have cured for time period recommended by waterproofing manufacturer, are free from release agents, curing agents, laitance, and other contaminates, and have adequate profile for adhesion of product.
2. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
3. Test for waterproofing adhesion per manufacturer's recommended method.
4. Verify masonry joints are filled with mortar and struck flush.
5. Verify drains have suitable flanges at membrane level flush with deck surface.
6. Verify deck penetrations including pipes, conduits, and vents are rigidly installed and flashed and ready to receive waterproofing application.
7. Notify Architect of unsatisfactory conditions.

B. Surface Condition for Vegetated Roof: Examine surfaces and report any adverse conditions which may negatively impact appearance or performance of vegetated roof system. Ensure all unacceptable conditions are corrected before proceeding. Coordinate sequencing of waterproofing work and vegetated roofing work with work of other sections.

1. Verify that roof insulation over membrane roofing is in place, secure, and flush along all seams.
2. Verify that perimeter and other flashings are in place and secure along entire lengths where they will be covered by vegetated roof assembly.

C. Ensure adequate provisions have been made for loading, unloading, storage, parking and access to roof site.

D. Execute work in accordance with the specification, drawings and details.

E. Report any imbedded object or obvious damage to Consultant.

F. Ensure all equipment is in good working order. Protect all equipment which comes into contact with roofing membrane, flashings and related work.

G. Ensure adequate safety equipment has been obtained for all operations.

H. Proceed with installation of vegetated roof assembly only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Protect structures, utilities, sidewalks, pavements, and other facilities and areas from damage caused by installation.

B. Protect waterproofing according to the following written recommendations to prevent damage and wear during examination, testing, installation, and remainder of construction period:

1. Clean, prepare, and treat substrates in accordance with waterproofing manufacturer's written instructions including published details.

    a. Mask adjacent finished surfaces.
    b. Remove contaminants and film-forming coatings from substrates.
    c. Remove projections and excess materials and fill voids with substrate patching material.
    d. Prepare and treat joints and cracks in substrate per ASTM D 4258 and waterproofing manufacturer's written instructions.
    e. Close off deck drains and other deck penetrations to prevent spillage and migration of waterproofing fluids.

2. Metal Flashings: Where metal flashings are substrate to waterproofing membrane, set the flashings in continuous bedding bead of urethane sealant; install sealant S-bead between metal laps and mechanically fasten to substrate along leading edges at every 4" on center, staggered linearly, to lay flat without fishmouths.
3. Detail Preparation: Prepare non-moving shrinkage cracks, large cracks, construction joints, expansion joints, projections and protrusions, penetrations, drains, and changes in plane in accordance with waterproofing manufacturer's written instructions and details, using accessory materials specified.

    a. Prime substrates as required.
    b. Adhere strips of elastomeric sheet to moving joints and large cracks by embedding in a layer of hot rubberized asphalt and overlay with coat of hot rubberized asphalt.

4. Transitions to Adjacent Materials: Install elastomeric and composite reinforced flashing to form connect and seal waterproofing material to adjacent components of building waterproofing system, including, but not limited to, roofing system waterproofing, exterior fenestration systems, door framing, and other openings

    a. Seal top of through-wall flashings to waterproofing with continuous transition strips of type recommended by waterproofing manufacturer for application.
    b. Install elastomeric sheets at terminations of waterproofing membrane according to manufacturer's written instructions.
    c. Install termination bars and mechanically fasten to top of elastomeric flashing sheet at terminations and perimeter of waterproofing.

3.3 WATERPROOFING INSTALLATION

A. General: Apply waterproofing material to form a seal with strips and transition strips and to achieve a continuous waterproofing according to waterproofing manufacturer's written instructions. Apply waterproofing material within manufacturer's recommended application temperature ranges.

B. Primer:

1. Apply primer to substrates at required rate, using roller, brush, or airless spray. Allow to dry.
2. Reprime areas not covered within 24 hours.

C. Membrane:

1. Install membrane according to manufacturer's written instructions.
2. Heat rubberized asphalt in an oil- or –air-jacketed melter with mechanical agitator specifically designed for heating rubberized asphalt.
3. Start application with manufacturer's authorized representative present.
4. Apply waterproofing in total wet film thickness recommended in writing by waterproofing manufacturer, but not less than 215-mil wet film thickness, applied in two or more equal coats applied using methods recommended by waterproofing manufacturer, as follows:

    a. Apply first coat at minimum thickness of 90 mils.
    b. Thoroughly embed reinforcing fabric in first coat while still liquid, with slight overlap of fabric edges.
    c. Apply second coat at not less than 125 mils and as required to achieve total thickness of not less than 215 mils.

D. Terminations:

1. Install terminations of waterproofing membrane in accordance with ASTM C 898 and ASTM C 1471, as application to application, at not less than minimum height recommended by waterproofing manufacturer.
2. Overlap waterproofing on to intersecting construction a minimum of 24 inches.

E. Coordination of Testing:

1. Coordinate application of waterproofing membrane with installation of membrane leak detection system.
2. Do not cover waterproofing until it has been tested and inspected by Owner's testing agency.

F. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates and reapply waterproofing components.

G. Separation/Protection Course Installation

1. Install protection course as per manufacturer's written instructions.

3.4 ELECTRONIC LEAK DETECTION GRID INSTALLATION

A. Measurement Grid: Install measurement on membrane substrate immediately under membrane and immediately prior to installation of membrane.

1. Verify that location of measurement grid fasteners does not interfere with or cause damage to membrane.
2. Fasten measurement grid in accordance with leak detection system manufacturer's requirements.
3. Do not place measurement grid where it will be in continuous direct contact with structural components.
4. Provide minimum 2 inch overlap where adjacent sheets meet, including side laps and end laps.
5. Cut measurement grid as close as possible to the perpendicular strand at both end and side edges

B. Conductor Wire: Install conductor wire on top of membrane at spacing and layout indicated on approved shop drawings.

C. Secure conductor wire using method recommended by manufacturer.

3.5 VEGETATED ROOF ASSEMBLY INSTALLATION

A. Installation, General: Install vegetated roof assembly components according to Manufacturer's written instructions and approved shop drawings.

B. Root Barrier:

1. Place root barrier continuously over finished membrane surface, including all vertical surfaces and projections.
2. Overlap all side and end laps a minimum of 4 inches and heat weld all seams watertight per Manufacturer’s specifications. Allow for root barrier to reach up all verticals 1-inch above the intended growing media line and secure below perimeter counter flashing with continuous termination bar per Manufacturer’s approved details.

C. Prefabricated Drainage Course:

1. Place prefabricated drainage course over root barrier layer, with filter fabric side facing up, over the entire surface of the roof area. Abut edges and ends between rolls.
2. Cut at edges, drains, and projections.

D. Horizontal Insulation:

1. Loosely lay insulation in parallel courses, staggering end laps and side laps. Abut edges and ends between units.
2. Cut insulation to fit neatly at projections and terminations with less that 1-inch tolerance.

E. Air Layer:

1. Place air layer over horizontal insulation over the surface of the vegetated area. Abut edges and ends between rolls.
2. Cut at edges, drains, and projections.

F. Moisture Retention Layer:

1. Place moisture retention layer over air layer, over the surface of the vegetated area. Abut edges and ends between rolls.
2. Cut at edges, drains, and projections.

G. Edging Restraint:

1. Install edging along perimeter border between vegetation-free area and vegetated area, according to Manufacturer’s instructions and approved shop drawings.
2. When joining two sections together, ensure a tight fit at all joints. Place edge connector piece on top so it overlaps both ends of joints. Secure with self-tapping screws.
3. At corners, cut and bend as required for clean, mitered finish. Finish with edge corner piece and secure with self-tapping screws.
4. Along slopes, use edge leveling strip as needed to create level, clean edging lengths. Install on outside of edging restraint, making sure to overlap the bottom of the leveling strip with the top of the edging restraint by a minimum of 2-inch. Secure with self-tapping screws.
5. Ensure base flange is pointed towards the vegetated areas.
6. Along the top of the edging restraint, on the vegetated side, install a 2-inch strip of Manufacturer’s double-coated technical tape below lip to accept filter fabric.
7. Secure edge of filter fabric trim roll to edging surface.

H. Drainage/Water Retention Component: Install panels with retention cup openings facing up, drainage holes at the top.

1. Lay drainage/water retention component panels over insulation up to vertical edging.
2. Cut tightly around any projections, drains, etc.
3. Work from top to bottom, left to right, securing panel edges together with built-in locking clips.
4. Fill retention cups with lightweight aggregate in line with the top of the drainage/water retention component.

I. Drain Inspection Box:

1. Install inspection box centered over drains directly on top of drainage/water retention component layer. Ensure the bottom inner edge of the inspection box is outside of the outer edge of the drain flange.
2. Wrap filter fabric trim roll along perimeter edge of inspection box wall. Adhere edge of filter fabric over lip, to top of inside edge with manufacturer's technical tape.
3. At locking pins, cut slits in fabric to fit around locking pins. Adhere to top inside edge with manufacturer's technical tape.
4. Insert retaining pin into locking pin to lock lid of inspection box.

J. Filter Fabric:

1. Lay a layer of filter fabric over drainage/water retention component layer, allowing for minimum 4 inches overlap between rolls.
2. Bond all seams between rolls with Manufacturer's technical tape.
3. Cut tightly around any projections, drains, etc.
4. At drains, projections, and perimeters of vegetated area, bond filter fabric trim roll pieces to the surface of filter fabric layer with Manufacturer's technical tape. Provide sufficient slack in fabric and allow 4 inches overlap for excess filter fabric.
5. Install growing media immediately following installation or provide temporary ballast.

K. Continuous Growing Media Handling and Placement: Place growing media for continuous growing planted areas with equipment and methods approved by Manufacturer.

1. Deliver and handle growing media in accordance with Manufacturer's requirements and the following:

    a. Do not deliver or place growing media in frozen, wet, or muddy conditions. Place material at optimum compaction moisture content as determined by AASHTO T 99 (ASTM D 698). Do not place materials in excessively moist condition.
    b. Protect structure from excess stockpiling loads. Consult structural engineer regarding safe loading of structure.
    c. Deliver growing media to be hand placed packaged in protective bags.
    d. Protect growing media from contamination and compaction.
    e. Protect stockpiled growing media from absorbing excess water, from erosion, and from exposure to airborne weed seeds. Protect stockpiled and placed growing media from compaction.

2. Final determination of growing media composition, depth, and supplements shall be by vegetated roof assembly Manufacturer based upon approved plant types and layout, subject to approval of Architect.

    a. Place growing media using truck-mounted, integrated, pneumatic blower unit, designed for this application, or by hand-placement. In order to ensure accuracy, the unit should be powered by its own separate diesel power unit, not PTO driven, and equipped with at least one computer-controlled supplemental granular injection system.
    b. The unit must be capable of uniformly applying materials and injected products at a rate greater than 15 cu. yd./hr at least to a vertical limit of 150 foot and must also be equipped with an application hose capable of extending 300 foot from the blower truck.
    c. Place growing media to within 1-inch above specified soil depth.
    d. Preset placed growing media by compacting with a landscape roller or by thoroughly watering planting area to achieve optimal compaction.
    e. Fill settled low areas with additional media and repeat compaction and filling process until settlement ceases and growing media is placed in uniform layer.
    f. Maintain proper moisture level of finish-graded growing media during vegetation placement.

L. Erosion Control Netting:

1. Erosion control netting to be installed as indicated on drawings and details. After growing media and seed mix are installed, stretch netting over growing media and fasten at edges with soil staple at 1-foot intervals. Fasten all seams with tie wrap fasteners at 8-foot intervals.

M. Vegetation:

1. Seed Mix:

a. In the event of a seeding application, the seed mix should be calibrated with the supplemental injection at the recommended seeding rate and applied in the top 1-inch of growing media prior to erosion netting being installed.

2. Perennial Plugs, Perennial Pots:

a. Where perennial plugs or pots are used, dig a hole in excess of the size of the root ball after extracting it from the pot. Lightly cover root ball, ensure plants are planted to their full root depth and gently tamp in place.
b. If netting is used, cut holes sufficient in size to plant through.

3. Shrubs, Trees:

a. Where shrubs or trees are used, dig a hole in excess of the size of the root ball. Lightly cover root ball, ensure plants are planted to their full root depth and gently tamp in place.
b. Stake as required.

3.6 VEGETATION-FREE ZONE INSTALLATION

A. Roof Pavers: To roofed area, place roof pavers and cut to fit. Push pavers against edging and ensure there is a tight fit between parapet wall and edging.

1. Install roof pavers on paver supports set according to Manufacturer's written instructions.
2. Tolerances:

a. Install pavers to vary not more than 1/16 inch in elevation between adjacent pavers and not more than 1/16 inch from surface plane elevation of individual paver.
b. Maintain tolerances of paving installation within 1/4 inch in 10 feet of surface plane in any direction.

B. To roofed area, apply aggregate ballast uniformly at rate required by manufacturer, but not less than the following, carefully spreading aggregate to not damage roofing membrane and base flashings. Apply ballast as insulation is installed, leaving roofing membrane insulated and ballasted at end of workday.

1. Ballast: 15 lb/sq. ft., aggregate within 102 inches of roof perimeter and corners and of roof penetrations; 10 lb/sq. ft. aggregate elsewhere.

a. Install two rows of walkway roof pavers in lieu of aggregate ballast at roof perimeter, corners, and penetrations, unless otherwise indicated on Drawings.

3.7 FIELD QUALITY CONTROL (BY OWNER)

A. Testing Agency: Owner will engage a qualified testing agency to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components, and to furnish reports to Architect.

1. Electric Field Vector Mapping (EFVM): Testing agency shall survey entire roof area for potential leaks using electric field vector mapping (EFVM).
2. Other testing protocols may be implemented at the discretion of the testing agency to evaluate installed conditions.

B. Vegetated roof system will be considered defective if it does not pass tests and inspections.

C. Repair or remove and replace components of vegetated roof system where inspections indicate that they do not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.8 FIELD QUALITY CONTROL (BY CONTRACTOR)

A. Manufacturer's Field Service: Contractor shall engage a manufacturer’s technical representative for technical assistance and guidance for preparation and application of vegetated roof system. At a minimum, arrange for manufacturer’s technical representative to observe installation of vegetated roof system during initial installation, at mid-point of the installation, and at completion. Provide additional field observation as required to obtain warranty specified and when requested by Architect or Owner. After each field visit, submit manufacturer’s written report of observations within 3 working days. The report shall note overall quality of work, deficiencies, and any other concerns, and recommend corrective action.

B. Final Roof Inspection: Arrange for vegetated roof system manufacturer's technical personnel to inspect waterproofing installation upon completion.

C. Roof Drain Test: After completing roofing, but prior to Substantial Completion, perform the following test for watertightness. Plug deck drains and fill with water to edge of drain sump for 8 hours. Do not plug secondary overflow drains at the same time as adjacent primary drain. To ensure some drainage from roof, do not test all drains at the same time. Measure water at beginning and end of the test period. When precipitation occurs during test period, repeat test. When water level falls, remove water, thoroughly dry, and inspect installation; repair or replace roofing at drain to provide for a properly installed watertight flashing seal. Repeat test until there is no water leakage.

1. When testing overflow drains, confirm that overflow drains are operating as intended.
2. Owner will engage an independent testing agency to observe roof drain test and examine underside of decks and terminations for evidence of leaks during roof drain testing.

D. Vegetated roof system will be considered defective if it does not pass tests and inspections.

E. Repair or remove and replace components of vegetated roof system where inspections indicate that they do not comply with specified requirements.

F. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

G. Prepare test and inspection reports.

3.9 PROTECTION

A. Do not permit foot or vehicular traffic on unprotected membrane.

B. Protect waterproofing from damage and wear during remainder of construction period.

C. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

D. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

E. Protect vegetated roof assemblies from damage, including growing-medium contamination, due to operations of other contractors and trades. Repair or replace damaged vegetated roof assemblies.

3.10 MAINTENANCE SERVICE

A. Maintenance Service: Provide maintenance by skilled employees of vegetated roof assembly Installer approved by roofing-membrane manufacturer. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than the specified maintenance period.

1. Assembly and Plant Maintenance: During maintenance period, maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing devices, resetting plants to proper elevations or vertical position, and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.

    a. Replace growing medium that becomes displaced or eroded because of settling or other processes.
    b. Apply treatments as required to keep plant materials, planted areas, and growing medium free of pests and pathogens or disease. Use integrated past management practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.
    c. Use only products and methods acceptable to roofing-membrane manufacturer.

2. Maintenance Period: 12 months from date of Substantial Completion.

END OF SECTION 077273

SECTION 077616 – ROOF DECKING PAVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Furnish and install a complete Architectural Pavers and Adjustable Pedestals deck support system with a maximum cavity height of up to 22 inches.

B. Related Requirements:

1. Division 02 - Section 02780 Unit Pavers
2. Division 03 - Section 03300 Cast-in-Place Concrete.
3. Division 06 - Section 06100 Rough Carpentry.
4. Division 07 - Section 07760 Roof Pavers.
5. Division 07 - Section 07620 Roof related Metal Work.
6. Division 07 - Section 07540 Fluid Applied Waterproofing.
7. Division 07 - Section 07540 Bituminous Sheet Waterproofing.
8. Division 07 - Section 07760 Roof Pavers.

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM)

1. ASTM D 638 - Tensile Properties of Plastics
2. ASTM D 790 - Flexural Properties of Unreinforced and Reinforced Plastics Insulating
3. ASTM D 1525 -Vicat Softening Temperature of Plastics

1.4 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Samples:

1. Architectural Pavers: Submit samples for type, color and texture required.
2. Pedestals: Submit sample of each pedestal component.
3. PVC Pipe: Submit 12-inch long sample of PVC pipe.

C. Shop Drawings: Submitted by contractor showing all components required for the paver & pedestal requirements. Shop drawings shall include plan drawings showing layout of all paver areas and detail drawings showing how the various components of the system fit together. Include manufacturer's literature completely describing all components of the paver pedestal systems and giving detailed installation recommendations and instructions. Also included detailed installation drawings for all precast pavers.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: All products covered under this Section shall be produced by a single manufacturer unless otherwise specified with a minimum of fifteen (15) years proven production experience.

B. Installer Qualifications: Installer shall have a minimum of three (3) years proven construction experience and be capable of estimating & building from blueprint plans and details, determining elevations, in addition to proper material handling. All Work must comply with Tile Tech Pavers installation application procedures for pedestal mounted pavers as specified herein.

C. Special Consideration: The installer and or subcontractor must assume the responsibility for and take into consideration (1) the structural capability and adequacy of the structure to carry the dead and live load weight(s) involved, and (2) that the density of any insulation is satisfactory to resist crushing and damaging the waterproofing membrane.

1.6 DELIVERY, STORAGE, AND HANDLING

A. In accordance with provisions of Section 01300.

B. Protect Concrete Pavers and Pedestal System during shipment, storage and construction against damage. Store a minimum of 4 inches off the ground in a dry location and cover with polyethylene to protect from contact with materials which would cause staining or discoloration.

1.7 PROJECT CONDITIONS

A. Tile Tech Pedestal System specified are to be used with pedestrian traffic only & all four (4) sides of a deck system must restrain and contain the decking panels with perimeter blocking or walls. Decking panels must not be allowed to move laterally.

B. All membrane waterproofing and protection board surfaces to receive pedestals must be broom clean, frost free, and free of dirt, oil or any rough foreign matter, which may impair the waterproofing / roofing manufacturers guarantee or protection requirements.

C. The substrate that is to receive pedestals must have slope and provide positive and adequate drainage in accordance with good building practice and applicable building codes

D. Decks over Roofing and Waterproofing:

1. If high density closed cell extruded 60psi polystyrene insulation is installed on top of the membrane in a protected membrane system, Tile Tech Pedestals may be installed directly on top of this type of insulation.
2. Do not use Tile Tech Pedestals over any insulation less than 60psi or with low density polystyrene (bead board) insulation.

E. Installation or anticipated installation of additional items on top of the deck such as planters, hot tubs, sculptures, or industrial equipment must be supported directly by additional pedestals that are in addition to the main deck paver/tile pedestal system. Failure to adequately support the additional weight of any such features or items may cause significant damage to the deck, underlying structure, or waterproofing.

1.8 WARRANTIES / GUARANTEES

A. Tile Tech Pedestal System (pavers and pedestals) shall remain free from defects for a period of ten (10) years. The contractor shall warrant that his work will remain free from defects of labor and materials used in conjunction with his work in accordance with the general conditions for this project or a maximum of three (3) years.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. The Paver Pedestal Systems specified herein are based upon products manufactured by:

Tile Tech Inc., 888-380-5575 Phone: (213) 380-5560 Fax: (213) 380-5561

E-mail: sales@tiletechpavers.com Website: www.tiletechpavers.com

B. Paver Pedestal Systems equal in appearance and function and meeting these specifications, will be acceptable when the specified submittals are approved in writing by the Architect prior to bid.

2.2 MATERIALS

A. IPE WOOD DECK TILES:

1. Type: IPE Wood Deck Tiles.
2. Color: Natural State.
3. Size: 24”x24”x1-5/8”
4. Finish: Smooth finished.
5. Weight: 6lb per Sqft.

B. CONCRETE PAVERS:

1. Type: Cool-Roof™
2. Color: Penny Lane.
3. Size: 12”x24”x1-1/2” nominal
4. Finish: Shot-blasted with 3/16” bevel on all four (4) sides of finished surface.
5. Weight: 11 to 22 lbs per square foot depending on paver size & thickness.

C. PEDESTALS:

1. Stak-Cap™ Pedestals: PVC Pipe & Stack Adjustable

a. Stack or use SDR35 PVC pipe to accommodate various HEIGHT adjustments of ½” to 2”.
b. Each cap provides maximum of ½” of HEIGHT and 1% SLOPE. Rotate and stack one cap relative to another to accommodate SLOPE adjustments from 0% to 5%.
c. Base diameter of 6-inch and top diameter of 5-¼-inch and is ½-inch high.
d. Made of high impact and flame resistant ABS plastic.
e. Use of Buffer Pads under Stak-Cap™ Pedestals is MANDATORY.

2. Uni-Just™ Pedestals: PVC Pipe & Screw Adjustable

a. Assembly consist of 5 parts: Uni-Base™, Uni-Collar™, Uni-Insert™, Uni-Cap™ & Buffer Pads.
b. Use SDR35 PVC pipe to accommodate various HEIGHT adjustments from 2-½" to 24". Additional precise height adjustment of up to 1-½" with the use of Uni-Insert™ which can screw up or down while loaded. Additional heights beyond 24" can be accomplished subject to consultation with manufacturer and approval by manufacturer.
c. Self-leveling and can tilt in any direction to a level plane to accommodate SLOPE adjustments from 0% to 6%.
d. Base diameter of 7.25-inch with bearing surface area of thirty eight (42) square inches.
e. Made of 100% recycled and flame resistant High Density Polypropylene.
f. Use of Buffer Pads under Uni-Just™ Pedestals is MANDATORY.

3. Uni-Shims™: 1/8-inch & 1/16-inch Thick

a. Can be used whole or broken into halves or quarters and can be stacked up to 2 high.
b. Used on top or under Stak-Cap™ or Uni-Just™ Pedestals for fine leveling of pedestals and or individual pavers.
c. Made of high impact and flame resistant ABS plastic.

D. OTHER COMPONENTS: INSTALLER OR USER SUPPLIED

1. Pedestal Pipe: 4-inch diameter SDR35 PVC Sewer Pipe

a. Used with either Stak-Cap™ or Uni-Just™ Pedestals and is cut to required height.
b. Dimensions: 4.215-inch outside diameter & 3.890-inch inside diameter.
c. Meet ASTM D-3034 and F-679.
d. NOT supplied with pedestal components by Tile Tech Pavers.

2. Protection Course:

a. Protection board (required over insulated BUR systems, and when specified for use over bituminous asphalt-based waterproofing): W.R. Meadows "Vibraflex" or equal, minimum 3/8- inch thick asphaltic composition protection board.
b. Insulation (when specified): Dow Styrofoam "Highload 100" or equal, minimum compressive strength of 100psi recommended for foam plastic insulation placed beneath Pedestal System to prevent damage to the waterproofing membrane.
c. NOT supplied with pedestal components by Tile Tech Pavers.

2.3 PERIMETER CONTAINMENT AND SUPPORT

A. The complete assembly of insulation (if used), protection board (if used), drainage mat (if used), pedestals and pavers must be restrained at the perimeter of the deck area.

B. Perimeter parapet walls, concrete dividers or other perimeter restraint must be capable of resisting lateral forces (including seismic and wind). Cumulative movement in excess of 1/8 inch will void the Tile Tech Pavers Pedestal System warranty.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Prior to starting work inspect the substrate to ensure that it has been properly prepared to accept the Tile Tech Pedestal System. The substrate and or surface shall be clean and free of any projections and debris which may impair the performance of the pedestal and or the deck system. Verify all elevations, required pedestal heights and deck dimensions. Commencement of work shall imply acceptance of surfaces & deck conditions.

B. If preparation is the responsibility of another installer, notify Architect in writing of deviations from manufacturer's recommended installation tolerances and conditions.

3.2 PREPARATION

A. The substrate surface that will receive the Pedestal System must be well compacted (on Grade) or structurally capable of carrying the dead and live loads anticipated.

1. Insulation OVER the membrane: (Option 1) Insulation and/or protection board (if specified) must be applied over the waterproofing substrate and/or specified drainage mat. Install the system according to the membrane manufacturer's recommendations and specifications.
2. Insulation UNDER membrane: (Option 2) Insulation required to be installed within a roofing system below deck supports must meet the roofing membrane manufacturers' specifications and must have a minimum core density of 60psi.
3. Protection Board: (for asphalt type systems used over waterproofing) Full coverage 1/8-inch asphaltic composition protection board is recommended. When protection is specified only under the pedestal cut protection board pads to extend beyond the outside perimeter of the pedestal system base or buffer pad by a minimum of TWO (2) inch.
4. Drainage Mat: (when desired or specified) Install drainage mat according to the manufacturers recommendations to avoid crushing.

3.3 INSTALLATION

A. Install in accordance with Tile Tech Pavers and other contributing manufacturer's instructions. Installation requirements vary for each individual project site. Decking paver or tile used, pattern, grid layout, starting point, and finished elevation should be shown on plan view shop drawings, which have been prepared and approved by the designer, installing contractor and/or owner.

B. GRID LAYOUT AND ELEVATIONS:

5. Once the starting point and the finished elevation of the deck surface have been determined, the "Top of Pedestal Elevation" (finished elevation less decking paver or tile thickness) is established and marked around the perimeter using a transit water level or laser leveling device.
6. Precise measurements should be taken and deck area should be accurately defined. Mark off and 'square up' all outside edges with control lines using "snapped" chalk lines. Mark two (2) lines that are perpendicular to each other across the deck area. Continue to mark a grid of lines in both directions marking the location of each pedestal. Use the control lines as references to periodically check and assure a square layout during installation.
7. Next, a pedestal must be placed where each measured grid line meets the perimeter. Remove two (2) spacer tabs in line with one another atop each pedestal system placed around the perimeter. Remove all four (4) spacer tabs at corners.

8. Adjust each pedestal height to the “Top of Pedestal Elevation” marked on the perimeter. Position the pedestal as close to the edge of the perimeter as possible, with the two remaining spacer tabs aligned with the grid line. Using the elevation marked on the perimeter, stretch a mason’s line along and slightly ahead of the second row of pedestals. A laser leveling device may also be used for this purpose.
9. On larger decks, it is recommended that Tile Tech Pedestal System be pre-assembled and pre-set to the proper elevation and placed in position prior to the installation of decking paver or tile.
10. As the pedestals located along the grid lines are loaded with pavers or tiles, fine vertical height adjustment can be made by inserting and rotating, from the top, a T-handle Hex Key in to the Uni-Insert™ of the Pedestal assembly. Clockwise rotation of the Uni-Insert™ will raise the bearing surface and the deck. Counter-clockwise rotation will lower the top bearing surface and deck.
11. Always maintain adequate thread engagement. Tile Tech Pedestal Uni-Insert™ contains a locking tab that will not allow the screw to extend past its maximum extension. Never use if the locking tab is broken. If the height required goes beyond the Uni-Insert™ limit re-cut PVC pipe to the correct height and re-assemble the pedestal using the correct size pipe.
12. Slight irregularities in decking paver or tile thickness can be compensated for by using one (1) to two (2) shim segments. Place on top of the pedestal, under the corner(s) of the decking paver or tile. Use no more than two (2) shims on top of the pedestal and always adhere quartered (1/4) wedges with construction adhesive.
13. Stak-Cap™ Pedestal can be used for limited and or fixed height requirements. Complete deck and grid layout as instructed above. Stack no more than five (5) fixed height Stak-Cap™ Pedestals together and place in lieu of Uni-Just™ Pedestals where needed. Stak-Cap™ Pedestal can also be used with PVC pipe to reduce cost. Spacer tabs can be removed to accommodate perimeter and corner support locations.

C. SLOPE AND HEIGHT COMPENSATION:

1. Stak-Cap™ Pedestals can provide limited slope and height compensation to maintain a level decking surface over sloping substrates and is accomplished using a combination of the following:

    a. Rotate and stack one cap in relation to another to change slope and add height. Each cap will add ½-inch of height and provide 1% slope. Stack no more than 5 caps.
    b. Can also be used with PVC Pipe cut to required height of maximum of 6-inches.

2. Uni-Just™ Pedestals can provide both slope and height compensation to maintain a level decking surface over sloping substrates and is accomplished using a combination of the following:

    a. PVC Pipe cut to varying lengths to compensate for GENERAL height requirements.
    b. SCREW extension for PRECISE height adjustment.
    c. Self-Leveling cap that pivots and tilts in any direction for slope compensation from 0% to 6%.

3. Tile Tech Pedestals are designed to be rotated for final precise adjustment when they are fully loaded. Pedestals should be leveled in each succeeding row as the installation proceeds. Final height adjustment or maintenance is easily made by simply using a T-handle Hex Key that allows you to adjust the pedestals without removing the pavers. T-handle Hex Key is inserted between the four paver corners to engage Uni-Insert™ portion and is adjusted clockwise or counter clockwise to level as needed.

4. Uni-Shims™ may be used in multiples, whole or quarters, and placed under the pedestal base or on top the pedestal cap to level pedestals. Use a small amount of construction adhesive to adhere sections of shims and/or whole shims to each other or to the pedestal. DO NOT use construction adhesive to adhere pedestal or shims to insulation, roofing or waterproofing membrane. Additional sections of shims may be used and should be available for regular maintenance.

3.4 PERIMETER CONTAINMENT

A. Any area of the pedestal deck that is not restrained by a parapet or foundation wall must be 'boxed-in' and contained. The deck panels will move if all sides are not adequately restrained. Perimeter framing and edging boards located at the outside of the deck perimeter must be installed to provide restraint. No movement should be allowed at the perimeter of the deck system greater than one tab width.

3.5 FIELD QUALITY CONTROL

A. Inspect often during installation to assure that grid spacer lines are being maintained in a straight and consistent pattern and that deck pavers or tiles are level and not rocking. Unless otherwise specified in writing to allow for expansion, inspect to assure that all paver spacing between tiles and at perimeter walls does not exceed a tab width. Particular attention should be made to assure that all pedestrian entry or access points to the deck are level and that the deck surface tiles are not randomly raised or uneven creating a tripping or safety hazard. Confirm that deck pedestal height excess of sixteen (16) inches have been braced in accordance with Tile Tech Pavers written instructions.

3.6 ROUTINE MAINTENANCE AND CARE

A. The deck owner must perform routine maintenance of the deck. Check for rocking pavers and adjust using T-Handle Hex Key or shim immediately. Pedestals can settle and may have to be realigned. Failure to do so can cause a tripping hazard. Periodically check spacer tabs and immediately replace broken tabs to limit deck movement. Make sure the edge restraint stays intact and structurally sound.

B. Extra Materials: Deliver supply of maintenance materials to the owner. Furnish not less than 1 percent maintenance materials from same lot as materials installed, and enclosed in protective packaging with appropriate identifying labels.

END OF SECTION 077616

SECTION 078100 - APPLIED FIREPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes sprayed fire-resistive materials.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for coordination of steel surface preparation with this Section.
2. Section 078123 "Intumescent Fireproofing" for mastic and intumescent fire-resistive coatings.

1.3 DEFINITIONS

A. CBC: 2016 California Building Code.

B. SFRM: Sprayed fire-resistive materials.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review products, design ratings, restrained and unrestrained conditions, densities, thicknesses, bond strengths, and other performance requirements.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: Product data indicating VOC content of each product used.

C. Shop Drawings: Framing plans and schedules, indicating the following:

1. Extent of fireproofing for each construction and fire-resistance rating.
2. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
3. Minimum fireproofing thicknesses needed to achieve required fire-resistance rating of each structural component and assembly.
4. Treatment of fireproofing after application.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Product Certificates: For each type of fireproofing.

C. Research / Evaluation Reports: For fireproofing, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

D. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of applied fireproofing that has been used for similar applications with successful results, that meets or exceeds performance requirements indicated, and of documenting this performance by inclusion in test reports and ICC evaluation reports. Manufacturer shall have factory-authorized service representatives who are available for consultation, periodic Project-site observations, and on-site assistance.

B. Installer Qualifications: A firm with not less than 5 years' experience installing applied fireproofing similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not apply fireproofing when ambient or substrate temperature is 44 deg F or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.

B. Ventilation: Ventilate building spaces during and after application of fireproofing, providing complete air exchanges according to manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fireproofing dries thoroughly.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Assemblies: Provide fireproofing, including auxiliary materials, according to requirements of each fire-resistance design and manufacturer's written instructions.

B. Fire-Resistance Design: Indicated on Drawings, tested according to ASTM E 119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Steel members are to be considered unrestrained unless specifically noted otherwise.

C. VOC Content: Products shall comply with VOC content limits of authorities having jurisdiction.

1. SFRM: 0 g/L.

D. Asbestos: Provide products containing no detectable asbestos.

2.2 SPRAYED FIRE-RESISTIVE MATERIALS

A. Sprayed Fire-Resistive Material UL D916: Manufacturer's standard, factory-mixed, lightweight, dry formulation, complying with indicated fire-resistance design, and mixed with water at Project site to form a slurry or mortar before conveyance and application.

1. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

a. Isolatek International.

1) Type I: Cafco 300.
2) Type II: Fendolite M-II.

b. Or comparable equal, subject to compliance with requirements herein and with Section 016000 "Product Requirements."

2. Source Limitations: Obtain applied fireproofing products from single source from single manufacturer.

3. Application:

    a. Provide Type II SFRM in the following locations:

        1) Where Type I is not permitted per manufacturer's written evaluation report:
        2) Areas outside of the conditioned building envelope.
        3) Where exposed to elevator hoistway or elevator machine room.
        4) Non-ducted ventilation shafts.
        5) Interior spaces and rooms, where exposed and subject to contact, including, but not limited to, the following:

            a) Exposed columns in warehouse area.

        6) In other locations required by Authorities Having Jurisdictions and where indicated.

    b. Provide Type I SFRM in all other locations.
    c. Where outside of the building envelope, applied fireproofing shall be designated for exterior use by a qualified testing agency acceptable to authorities having jurisdiction.

4. Bond Strength: Provide the following minimum cohesive and adhesive strength based on field testing according to ASTM E 736.

    a. Type I: 150-lbf/sq. ft.
    b. Type II: 1,000-lbf/sq. ft.

5. Density: Not less than density specified in the approved fire-resistance design, according to ASTM E 605.

    a. Type I: 15 lb./cu. ft.
    b. Type II: 40 lb./cu. ft.

6. Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design or ASTM E 605, whichever is thicker, but not less than 0.375 inch.
7. Combustion Characteristics: ASTM E 136.
8. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

    a. Flame-Spread Index: 10 or less.
    b. Smoke-Developed Index: 10 or less.

9. Compressive Strength: Provide the following minimum compressive strengths according to ASTM E 761:

    a. Type I: 20 lbf/sq. in.
    b. Type II: 300 lbf/sq. in.

10. Corrosion Resistance: No evidence of corrosion according to ASTM E 937.
11. Deflection: No cracking, spalling, or delamination according to ASTM E 759.
12. Effect of Impact on Bonding: No cracking, spalling, or delamination according to ASTM E 760.
13. Air Erosion: No weight loss in 24 hours according to ASTM E 859.
14. Fungal Resistance: Treat products with manufacturer's standard antimicrobial formulation to result in no growth on specimens per ASTM G 21 or rating of 10 according to ASTM D 3274 when tested according to ASTM D 3273.
15. Material shall have been evaluated and reported by Underwriters Laboratory or International Code Council Evaluation Services (ICC-ES). A valid Evaluation Service Report Number shall be provided ensuring code compliance.

2.3 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that are compatible with fireproofing and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.

B. Substrate Primers: Primers approved by fireproofing manufacturer and complying with one or both of the following requirements:

1. Primer and substrate are identical to those tested in required fire-resistance design by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
2. Primer's bond strength in required fire-resistance design complies with specified bond strength for fireproofing and with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction, based on a series of bond tests according to ASTM E 736.

C. Bonding Agent: Product approved by fireproofing manufacturer and complying with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction.

D. Metal Lath: Expanded metal lath fabricated from material of weight, configuration, and finish required, according to fire-resistance designs indicated and fireproofing manufacturer's written instructions. Include clips, lathing accessories, corner beads, and other anchorage devices required to attach lath to substrates and to receive fireproofing.

E. Reinforcing Fabric: Glass- or carbon-fiber fabric of type, weight, and form required to comply with fire-resistance designs indicated; approved and provided by fireproofing manufacturer.

F. Reinforcing Mesh: Metallic mesh reinforcement of type, weight, and form required to comply with fire-resistance design indicated; approved and provided by fireproofing manufacturer. Include pins and attachment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and according to each fire-resistance design.

1. Verify that substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants, or other foreign substances capable of impairing bond of fireproofing with substrates under conditions of normal use or fire exposure.
2. Verify that objects penetrating fireproofing, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
3. Verify that substrates receiving fireproofing are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fireproofing application.

B. Verify that concrete work on steel deck is complete before beginning fireproofing work.

C. Verify that roof construction, installation of rooftop HVAC equipment, and other related work are complete before beginning fireproofing work.

D. Conduct tests according to fireproofing manufacturer's written instructions to verify that substrates are free of substances capable of interfering with bond.

E. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Cover other work subject to damage from fallout or overspray of fireproofing materials during application.

B. Clean substrates of substances that could impair bond of fireproofing.

C. Prime substrates where included in fire-resistance design and where recommended in writing by fireproofing manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive fireproofing.

D. For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of fireproofing. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

3.3 APPLICATION

A. Construct fireproofing assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, sealers, topcoats, finishing, and other materials and procedures affecting fireproofing work.

B. Comply with fireproofing manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fireproofing; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.

C. Coordinate application of fireproofing with other construction to minimize need to cut or remove fireproofing.

1. Do not begin applying fireproofing until clips, hangers, supports, sleeves, and other items penetrating fireproofing are in place.
2. Defer installing ducts, piping, and other items that would interfere with applying fireproofing until application of fireproofing is completed.

D. Metal Decks:

1. Do not apply fireproofing to underside of metal deck substrates until concrete topping, if any, is completed.
2. Do not apply fireproofing to underside of metal roof deck until roofing is completed; prohibit roof traffic during application and drying of fireproofing.

E. Install auxiliary materials as required, as detailed, and according to fire-resistance design and fireproofing manufacturer's written instructions for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by fireproofing manufacturer.

F. Spray apply fireproofing to maximum extent possible. After the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by fireproofing manufacturer.

G. Extend fireproofing in full thickness over entire area of each substrate to be protected.

H. Install body of fireproofing in a single course unless otherwise recommended in writing by fireproofing manufacturer.

I. Cure fireproofing according to fireproofing manufacturer's written instructions.

J. Do not install enclosing or concealing construction until after fireproofing has been applied, inspected, and tested and corrections have been made to deficient applications.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Test and inspect as required by the CBC Section 1705.14, “Sprayed Fire-Resistant Materials."

B. Perform the tests and inspections of completed Work in successive stages. Do not proceed with application of fireproofing for the next area until test results for previously completed applications of fireproofing show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.

C. Fireproofing will be considered defective if it does not pass tests and inspections.

1. Remove and replace fireproofing that does not pass tests and inspections, and retest.
2. Apply additional fireproofing, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.

D. Prepare test and inspection reports.

3.5 CLEANING, PROTECTING, AND REPAIRING

A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

B. Protect fireproofing, according to advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fireproofing is without damage or deterioration at time of Substantial Completion.

C. As installation of other construction proceeds, inspect fireproofing and repair damaged areas and fireproofing removed due to work of other trades.

D. Repair fireproofing damaged by other work before concealing it with other construction.

E. Repair fireproofing by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

END OF SECTION 078100

SECTION 078123 - INTUMESCENT FIREPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes mastic and intumescent fire-resistive coatings.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for coordination of steel surface preparation with this Section.
2. Section 078100 "Applied Fireproofing" for sprayed fire-resistive materials (SFRM).

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review products, design ratings, restrained and unrestrained conditions, thicknesses, and other performance requirements.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: Product data for intumescent fireproofing, indicating VOC content.

C. Shop Drawings: Framing plans and schedules, indicating the following:

1. Extent of fireproofing for each construction and fire-resistance rating.
2. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
3. Minimum fireproofing thicknesses needed to achieve required fire-resistance rating of each structural component and assembly.
4. Treatment of fireproofing after application.

D. Samples: For each exposed product and for each color and texture specified, 4 inches square in size.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Manufacturer and Installer.

B. Product Certificates: For each type of fireproofing.

C. Evaluation Reports: For fireproofing, from ICC-ES.

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of intumescent fireproofing that has been used for similar applications with successful results, that meets or exceeds performance requirements indicated, and of documenting this performance by inclusion in test reports and ICC evaluation reports. Manufacturer shall have factory-authorized service representatives who are available for consultation, periodic Project-site observations, and on-site assistance.

B. Installer Qualifications: A firm with not less than 5 years' experience installing intumescent fireproofing similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Build mockup of each type of fireproofing and different substrate and each required finish as shown on Drawings.
2. Subject to acceptance by manufacturer and compliance with test data, apply in multiple lifts if required to match Architect's design reference sample and approved samples.
3. If preliminary intumescent fireproofing mockups are not approved by Architect, provide additional mockups as requested by Architect until mockups have been approved. Additional mockups shall be provided at no added cost to Owner.
4. Obtain Architect's approval of mockups before application of intumescent fireproofing.
5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not apply fireproofing when ambient or substrate temperature is 50 deg F or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.

B. Ventilation: Ventilate building spaces during and after application of fireproofing, providing complete air exchanges according to manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fireproofing dries thoroughly.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Assemblies: Provide fireproofing, including auxiliary materials, according to requirements of each fire-resistance design and manufacturer's written instructions.

B. Source Limitations: Obtain fireproofing from single source.

C. Fire-Resistance Design: Indicated on Drawings, tested according to ASTM E 119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Steel members are to be considered unrestrained unless specifically noted otherwise.

D. VOC Content: Applied topcoat products shall comply with VOC content limits of authorities having jurisdiction.

1. Coatings: 50 g/L.

E. Asbestos: Provide products containing no detectable asbestos.

2.2 MASTIC AND INTUMESCENT FIRE-RESISTIVE COATINGS

A. Mastic and Intumescent Fire-Resistive Coating: Manufacturer's standard, factory-mixed formulation or factory-mixed, multicomponent system consisting of intumescent base coat and topcoat, and complying with indicated fire-resistance design.

1. Subject to compliance with requirements, provide intumescent fireproofing by one of the following:

a. Albi Manufacturing; Albi Clad TF.
b. Carboline Company; A/D Firefilm III.
c. Isolatek International; Cafco Sprayfilm.

2. Application: Designated for "exterior," "interior general purpose," and "conditioned interior space purpose" use by a qualified testing agency acceptable to authorities having jurisdiction.
3. Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design.
4. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 50 or less.

5. Finish: Match approved mockup.

a. Color and Gloss: Custom, to match Architect’s sample.

2.3 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that are compatible with fireproofing and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.

B. Substrate Primers: Primers approved by fireproofing manufacturer and complying with required fire-resistance design by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

C. Reinforcing Fabric: Glass- or carbon-fiber fabric of type, weight, and form required to comply with fire-resistance designs indicated; approved and provided by fireproofing manufacturer.

D. Reinforcing Mesh: Metallic mesh reinforcement of type, weight, and form required to comply with fire-resistance design indicated; approved and provided by fireproofing manufacturer. Include pins and attachment.

E. Topcoat: Suitable for application over applied fireproofing; of type recommended in writing by fireproofing manufacturer for each fire-resistance design.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and according to each fire-resistance design.

1. Verify that substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants, or other foreign substances capable of impairing bond of fireproofing with substrates under conditions of normal use or fire exposure.
2. Verify that objects penetrating fireproofing, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
3. Verify that substrates receiving fireproofing are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fireproofing application.

B. Conduct tests according to fireproofing manufacturer's written instructions to verify that substrates are free of substances capable of interfering with bond.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Cover other work subject to damage from fallout or overspray of fireproofing materials during application.

B. Clean substrates of substances that could impair bond of fireproofing.

C. Prime substrates where included in fire-resistance design and where recommended in writing by fireproofing manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive fireproofing.

D. For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of fireproofing. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

3.3 APPLICATION

A. Construct fireproofing assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, topcoats, finishing, and other materials and procedures affecting fireproofing work.

B. Comply with fireproofing manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fireproofing; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.

C. Coordinate application of fireproofing with other construction to minimize need to cut or remove fireproofing.

1. Do not begin applying fireproofing until clips, hangers, supports, sleeves, and other items penetrating fireproofing are in place.
2. Defer installing ducts, piping, and other items that would interfere with applying fireproofing until application of fireproofing is completed.

D. Install auxiliary materials as required, as detailed, and according to fire-resistance design and fireproofing manufacturer's written instructions for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by fireproofing manufacturer.

E. Spray apply fireproofing to maximum extent possible. After the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by fireproofing manufacturer.

1. Subject to acceptance by manufacturer and compliance with test data, apply in multiple thin coats to achieve finish to match approved samples and approved mockup.

F. Extend fireproofing in full thickness over entire area of each substrate to be protected.

G. Install body of fireproofing in a single course unless otherwise recommended in writing by fireproofing manufacturer.

H. Provide a uniform finish complying with description indicated for each type of fireproofing material and matching finish approved for required mockups.

I. Cure fireproofing according to fireproofing manufacturer's written instructions.

J. Do not install enclosing or concealing construction until after fireproofing has been applied, inspected, and tested and corrections have been made to deficient applications.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Test and inspect as required by the 2016 California Building Code, Section 1705.15, the manufacture's ICC ES evaluation report, and authorities having jurisdiction.

B. Perform the tests and inspections of completed Work in successive stages. Do not proceed with application of fireproofing for the next area until test results for previously completed applications of fireproofing show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.

C. Fireproofing will be considered defective if it does not pass tests and inspections.

1. Remove and replace fireproofing that does not pass tests and inspections, and retest.
2. Apply additional fireproofing, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.

D. Prepare test and inspection reports.

3.5 CLEANING, PROTECTING, AND REPAIRING

A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

B. Protect fireproofing, according to advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fireproofing is without damage or deterioration at time of Substantial Completion.

C. As installation of other construction proceeds, inspect fireproofing and repair damaged areas and fireproofing removed due to work of other trades.

D. Repair fireproofing damaged by other work before concealing it with other construction.

E. Repair fireproofing by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

END OF SECTION 078123

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Penetrations in fire-resistance-rated walls.
2. Penetrations in horizontal assemblies.
3. Penetrations in smoke barriers.

B. Related Requirements:

1. Section 078443 "Joint Firestopping" for joints in or between fire-resistance-rated construction and in smoke barriers.

1.3 PREINSTALLATION MEETING

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For sealants, indicating VOC content.

C. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Manufacturer and installer.

B. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

C. Field quality control reports and special inspection reports.

1.6 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of penetration firestopping systems that have been used for similar applications with successful results, that meets or exceeds performance requirements indicated, and of documenting this performance by inclusion in test reports and/or Engineering Judgements. Manufacturer shall have factory-authorized service representatives who are available for consultation, periodic Project-site observations, and on-site assistance.

B. Installer Qualifications:

1. A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."
2. Engage an experienced installer who is certified, licensed or otherwise qualified by the firestopping manufacturer as having been provided the necessary training to install penetration firestopping per specified requirements. Manufacturer's willingness to sell its penetration firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualifications on buyer.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.9 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Penetration Firestopping Systems: Systems shall resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

1. Penetration firestopping shall comply with the requirements of the 2016 California Building Code (CBC).

B. Fire-Test-Response Characteristics:

1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:

a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.

1) UL in its "Fire Resistance Directory."
2) Intertek Group in its "Directory of Listed Building Products."
3) FM Global in its "Building Materials Approval Guide."

C. Sustainable Design Requirements: Penetration firestopping sealants and sealant primers shall comply with the following:

1. Sealants shall have a VOC content of 250 g/L or less.

D. Mold Resistance: Provide penetration firestopping and sealing with mold and mildew resistance rating of zero (0) as determined by ASTM G 21.

2.2 MANUFACTURERS

A. Subject to compliance with requirements, provide penetration firestopping by one of the following:

1. 3M Fire Protection Products.
2. Hilti, Inc.
3. Specified Technologies, Inc.

B. Obtain penetration firestopping systems from a single manufacturer.

2.3 PENETRATION FIRESTOPPING SYSTEMS

A. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.

1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

B. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.

1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.

C. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg.

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at and no more than 50-cfm cumulative total for any 100 sq. ft. at both ambient and elevated temperatures.

D. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.

E. Data, Video, and Communication Cable Penetrations: Bundle shall utilize an enclosed fire-resistant rated pathway device where cables penetrated a fire-resistant rated wall or smoke barrier. The fire-rated pathway shall contain a built-in fire sealing system sufficient to maintain the hourly fire resistance rating being penetrated. The self-contained sealing system shall automatically adjust to the installed cable loading and shall permit cables to be installed, removed, or retrofitted without the need to adjust, remove or reinstall firestop material. The pathway shall be UL Classified and/or PF Systems Approved and tested to the requirements of ASTM E 814 (UL 1479).

1. Subject to compliance with requirements, provide the following:

a. Specified Technologies, Inc., “EZ Path System.”
b. Or Equal.

F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

1. Permanent forming/damming/backing materials.
2. Substrate primers.
3. Collars.
4. Steel sleeves.

2.4 FILL MATERIALS

A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.

E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.

F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

2.5 MIXING

A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Prime substrates where recommended in writing by manufacturer. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

3.3 INSTALLATION

A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.

C. Install fill materials by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.

1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 30 feet.

3.5 FIELD QUALITY CONTROL (BY CONTRACTOR)

A. Manufacturer’s Field Services: Engage manufacturer’s representative for technical assistance and guidance for surface preparation and installation of penetration firestopping system. At a minimum, arrange for manufacturer’s representative to observe initial installation of each type of penetration firestopping system, at midpoint of installation, and at completion. Provide additional field observation when requested by Owner, Architect, or General Contractor. After each field visit, submit manufacturer’s written report of observations within 3 business days. The report shall note overall quality of work, deficiencies, and any other concerns, and recommend corrective actions.

B. If test results or inspections show penetration firestopping systems do not comply with requirements, repair or replace as recommended in writing by manufacturer, until penetration firestopping systems installation passes.

C. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

3.7 PENETRATION FIRESTOPPING SYSTEM SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.

B. Where Intertek Group-listed systems are indicated, they refer to design numbers in Intertek Group's "Directory of Listed Building Products" under "Firestop Systems."

C. Where FM Global-approved systems are indicated, they refer to design numbers listed in FM Global's "Building Materials Approval Guide" under "Wall and Floor Penetration Fire Stops."

D. Note: This schedule is schematic only. Contractor shall verify and submit final product list for approval. All firestop products shall be from a single manufacturer.

E. Firestop Systems with No Penetrating Items FS-1:

1. UL-Classified Systems: C-AJ-0001-0999, C-BJ-0001-0999, W-L-0001-0999.
2. Type of Fill Materials: One or more of the following:
   a. Latex sealant.
   b. Silicone sealant.
   c. Intumescent putty.
   d. Mortar.

F. Firestop Systems for Metallic Pipes, Conduit, or Tubing FS-2:

1. UL-Classified Systems: C-AJ-1001-1999, C-BJ-1001-1999, C-K-1001-1999, W-L- 1001-1999 .
2. Type of Fill Materials: One or more of the following:
   a. Latex sealant.
   b. Silicone sealant.
   c. Intumescent putty.
   d. Mortar.

G. Firestop Systems for Nonmetallic Pipe, Conduit, or Tubing FS-3:

1. UL-Classified Systems: C-AJ-2001-2999, C-BJ-2001-2999, W-L-2001-2999 .
2. Type of Fill Materials: One or more of the following:
   a. Latex sealant.
   b. Silicone sealant.
   c. Intumescent putty.
   d. Intumescent wrap strips.
   e. Firestop device.

H. Firestop Systems for Electrical Cables FS-4:

1. UL-Classified Systems: C-AJ-3001-3999, C-BJ-3001-3999, W-L-3001-3999..
2. Type of Fill Materials: One or more of the following:
   a. Latex sealant.
   b. Silicone sealant.
   c. Intumescent putty.
   d. Silicone foam.
   e. Pillows/bags.

I. Firestop Systems for Cable Trays FS-5:

1. UL-Classified Systems: C-AJ-4001-4999, C-BJ-4001-4999, W-K-4001-4999, W-L-4001-4999.
2. Type of Fill Materials: One or more of the following:
   a. Latex sealant.
   b. Intumescent putty.
   c. Silicone foam.
   d. Pillows/bags.
   e. Mortar.

J. Firestop Systems for Insulated Pipes FS-6:

1. UL-Classified Systems: C-AJ-5001-5999, C-BJ-5001-5999, W-L-5001-5999.
2. Type of Fill Materials: One or more of the following:
   a. Latex sealant.
   b. Intumescent putty.
   c. Silicone foam.
   d. Intumescent wrap strips.

K. Firestop Systems for Miscellaneous Electrical Penetrants FS-7:

1. UL-Classified Systems: C-AJ-6001-6999, F-A-6001-6999, W-L-6001-6999.
2. Type of Fill Materials: One or more of the following:
   a. Latex sealant.
   b. Intumescent putty.
   c. Mortar.

L. Firestop Systems for Miscellaneous Mechanical Penetrants FS-8:

1. UL-Classified Systems: C-AJ-7001-7999, F-C-7001-7999, W-J-7001-7999, W-L-7001-7999.
2. Type of Fill Materials: One or both of the following:
   a. Latex sealant.
   b. Mortar.

M. Firestop Systems for Groupings of Penetrants FS-9:

1. UL-Classified Systems: C-AJ-8001-8999, C-BJ-8001-8999, W-L-8001-8999.
2. Type of Fill Materials: One or more of the following:
   a. Latex sealant.
   b. Mortar.
   c. Intumescent wrap strips.
   d. Firestop device.
   e. Intumescent composite sheet.

END OF SECTION 078413

SECTION 078443 - JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Joints in or between fire-resistance-rated constructions.
2. Joints in smoke barriers.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers and for wall identification.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For sealants, indicating VOC content.

C. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Product Test Reports: For each joint firestopping system, for tests performed by a qualified testing agency.

C. Field quality control and special inspection reports.

1.6 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of joint firestopping systems that have been used for similar applications with successful results, that meets or exceeds performance requirements indicated, and of documenting this performance by inclusion in test reports and/or Engineering Judgements. Manufacturer shall have factory-authorized service representatives who are available for consultation, periodic Project-site observations, and on-site assistance.

B. Installer Qualifications:

1. A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."
2. Engage an experienced installer who is certified, licensed or otherwise qualified by the firestopping manufacturer as having been provided the necessary training to install fire-resistive joint systems per specified requirements. Manufacturer's willingness to sell its fire-resistive joint system products to Contractor or to Installer engaged by Contractor does not in itself confer qualifications on buyer.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Install and cure joint firestopping systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.9 COORDINATION

A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of joints to accommodate joint firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

1. Joint firestopping systems shall comply with the 2016 California Building Code (CBC).

B. Fire-Test-Response Characteristics:

1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:

a. Joint firestopping systems shall bear classification marking of a qualified testing agency.

1) UL in its "Fire Resistance Directory."
2) Intertek Group in its "Directory of Listed Building Products."

C. Sustainable Design Requirements: Fire-resistive joint system sealants shall comply with the following:

1. Sealants shall have a VOC content of 250 g/L or less.

D. Mold Resistance: Provide penetration firestopping and sealing with mold and mildew resistance rating of zero (0) as determined by ASTM G 21.

2.2 MANUFACTURERS

A. Subject to compliance with requirements, provide joint firestopping systems by one of the following:

1. 3M Fire Protection Products.
2. Hilti, Inc.
3. Specified Technologies Inc.

B. Obtain fire-resistive joint systems from a single manufacturer.

2.3 JOINT FIRESTOPPING SYSTEMS

A. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E 1966 or UL 2079.

1. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.

B. Joints in Smoke Barriers: Provide fire-resistive joint systems with ratings determined per UL 2079 based on testing at a positive pressure differential of 0.30-inch wg.

1. L-Rating: Not exceeding 5.0 cfm/ft. of joint at both ambient and elevated temperatures.

C. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

D. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Before installing fire-resistive joint systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:

1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.
2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Prime substrates where recommended in writing by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates.

3.3 INSTALLATION

A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.

C. Install elastomeric fill materials for fire-resistive joint systems by proven techniques to produce the following results:

1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Refer to “Identification” Article in Section 078413 “Penetration Firestopping” for wall identification.

3.5 FIELD QUALITY CONTROL (BY CONTRACTOR)

A. Manufacturer’s Field Services: Engage manufacturer’s representative for technical assistance and guidance for surface preparation and installation of joint firestopping systems. At a minimum, arrange for manufacturer’s representative to observe initial installation of each type of joint firestopping system, at midpoint of installation, and at completion. Provide additional field observation when requested by Owner, Architect, or General Contractor. After each field visit, submit manufacturer’s written report of observations within 3 business days. The report shall note overall quality of work, deficiencies, and any other concerns, and recommend corrective actions.

B. If test results or inspections show joint firestopping systems do not comply with requirements, repair or replace as recommended in writing by manufacturer, until joint firestopping systems installation passes.

C. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.

B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

3.7 JOINT FIRESTOPPING SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHBN or Category XHDG.

B. Where Intertek ETL SEMKO-listed systems are indicated, they refer to design numbers in Intertek ETL SEMKO's "Directory of Listed Building Products" under product category Firestop Systems.

C. General: This schedule is schematic. Contractor shall verify and submit final product list for approval. All firestop products shall be from a single manufacturer.

D. Floor-to-Wall Fire-Resistive Joint Systems:

1. UL-Classified Systems: FW-S-0000-0999
2. Assembly Rating: 1 or 2 hours as indicated.
3. Nominal Joint Width: As indicated.

E. Head-of-Wall Fire-Resistive Joint Systems

1. UL-Classified Systems: HW-D-0001-0999.
2. Assembly Rating: 1 or 2 hours as indicated.
3. Nominal Joint Width: As indicated.
4. Movement Capabilities: Class II and III – maximum 50 percent compression or extension.

F. Bottom-of-Wall, Fire Resistive Joint Systems

1. UL-Classified Systems: BW-S-0001-0999
2. Assembly Rating: 1 or 2 hours as indicated.
3. Nominal Joint Width: As indicated.

G. Wall-to-Wall Fire-Resistive Joint Systems:

1. UL-Classified Systems: WW-S-0000-0999.
2. Assembly Rating: 1 or 2 hours as indicated.
3. Nominal Joint Width: As indicated.

END OF SECTION 078443

SECTION 079100 - PREFORMED JOINT SEALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes preformed, foam joint with an extruded-silicone joint sealant face.

B. Related Requirements:

1. Section 079200 "Joint Sealants" for liquid sealants applied over preformed seals in dual seal systems.
2. Section 079513 "Exterior Expansion Joint Cover Assemblies" for exterior seismic joint cover assemblies.

1.3 ACTION SUBMITTALS

A. Product Data: For each preformed joint seal product.

B. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for each product exposed to view.

C. Samples for Verification: For each type and color of preformed joint seal required, provide Samples with joint seals in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint seals.

D. Preformed Joint Seal Schedule: Include the following information:

1. Joint seal location and designation.
2. Joint width and movement capability.
3. Joint seal manufacturer and product name.
4. Joint seal color.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Product Test Reports: For each preformed joint seal for tests performed by a qualified testing agency.

C. Warranties: For special warranties.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of preformed joint seals that have been used for similar applications with successful results, that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports and calculations. Manufacturer shall have factory-authorized service representatives who are available for consultation, periodic Project-site observations, and on-site assistance.

B. Installer Qualifications: A firm with not less than 5 years' experience installing preformed joint seals similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

C. Mockups: Install mockups of assemblies specified in other Sections that are indicated to receive preformed joint seals specified in this Section. Use materials and installation methods specified in this Section.

1.6 PROJECT CONDITIONS

A. Do not proceed with installation of preformed joint seals under the following conditions:

a. When ambient and substrate temperatures conditions are outside limits permitted by preformed joint seals manufacturer.
b. When joint substrates are wet.
c. When joint widths are less than those allowed by expansion control manufacturer for applications indicated.
d. Where contaminants capable of interfering with installation have not yet been removed from joint substrates.

1.7 WARRANTY

A. Special Manufacturer's Warranty: Manufacturer agrees to furnish preformed joint seals to repair or replace those that do not comply with performance and other requirements specified and/or fail to stop the passage of water within the specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PREFORMED, FOAM JOINT SEALS

A. Preformed, Foam Joint Seals: Manufacturer's standard joint seal manufactured from urethane or EVA (ethylene vinyl acetate) foam with minimum density of 10 lb/cu. ft. and impregnated with a nondrying, water-repellent agent. Factory produce in precompressed sizes in roll or stick form to fit joint widths based on design criteria indicated, with factory- or field-applied adhesive for bonding to substrates, with an extruded-silicone joint sealant face.

1. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

a. CS-Group, Inc. VF Series.

2. Design Criteria:

a. Nominal Joint Width: As indicated on Drawings.
b. Minimum Joint Width: As indicated on Drawings.
c. Maximum Joint Width: As indicated on Drawings.
d. Movement Capability: As indicated on Drawings.

3. Joint Seal Color: As selected by Architect from full range of industry colors.

2.2 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by preformed-joint-seal manufacturer for joint substrates indicated.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to preformed joint seal manufacturer, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces, and formulated to promote best adhesion to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with preformed joint seals and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive preformed joint seals, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting preformed-joint seal performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing preformed joint seals to comply with preformed joint seal manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of preformed joint seal, including dust, paints (except for permanent protective coatings tested and approved for seal adhesion and compatibility by seal manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimal bond with preformed joint seals. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

    a. Concrete.
    b. Masonry.
    c. Unglazed surfaces of ceramic tile.
    d. Exterior insulation and finish systems.

3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint seals. Nonporous joint substrates include the following:

    a. Metal.
    b. Glass.
    c. Porcelain enamel.
    d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by preformed joint seal manufacturer or as indicated by tests or prior experience. Apply primer to comply with joint seal manufacturer's written instructions. Confine primers to areas of joint seal bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of adhesive or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION

A. General: Comply with preformed joint seal manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.

B. Installation of Preformed, Foam Joint Seals:

1. Install each length of seal immediately after removing protective wrapping.
2. Firmly secure compressed joint seals to joint gap side to obtain full bond using exposed pressure-sensitive adhesive or field-applied adhesive as recommended by manufacturer.
3. Do not pull or stretch material. Produce seal continuity at splices, ends, turns, and intersections of joints.
4. For applications at low ambient temperatures, heat foam joint seal material in compliance with manufacturer's written instructions.
5. Apply masking tape to each side of joint, outside of area to be covered by seal system.
6. Apply silicone sealant to each side of joint to produce a bead of size complying with preformed silicone seal system manufacturer's written instructions and covering a bonding area of not less than 3/8 inch. Hold edge of sealant bead 1/4 inch inside masking tape.
7. Complete installation of seal system in horizontal joints before installing in vertical joints. Lap vertical joints over horizontal joints. At ends of joints, cut silicone extrusion with a razor knife.

3.4 PROTECTION

A. Protect preformed joint seals from damage resulting from construction operations or other causes so seals are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated seals immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 079100

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Urethane joint sealants.
3. Latex joint sealants.
4. Acoustical joint sealants.

B. Related Requirements:

1. Section 078443 "Joint Firestopping" for sealing joints in fire-resistant rated construction.
2. Section 092900 "Gypsum Board" for sealing perimeter joints.
3. Section 321373 "Concrete Paving Joint Sealants" for sealing joints in paved roads, parking lots, walkways, and curbing.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Transmit all action and informational submittal items together in one single complete submittal package for review.

B. Product Data: For each joint-sealant product, provide product data and identify substrates being joined.

C. Sustainable Design Submittals:

1. Product Data: For sealants, indicating VOC content.

D. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view. Identify substrates being joined.

E. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

F. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer, installer, and testing agency.

B. Product Test Reports: For each kind of joint sealant, for tests performed by a qualified testing agency.

C. Preconstruction Laboratory Test Schedule: Include the following information for each joint sealant and substrate material to be tested:

1. Joint-sealant location and designation.
2. Manufacturer and product name.
3. Type of substrate material.
4. Proposed test.
5. Number of samples required.

D. Preconstruction Laboratory Test Reports: From sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.

E. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.

F. Field-Adhesion-Test Reports: For each sealant application tested.

G. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of joint sealants that have been used for similar applications with successful results, that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports. Manufacturer shall have factory-authorized service representatives who are available for consultation, periodic Project-site observations, and on-site assistance

B. Installer Qualifications: A firm with not less than 10 years' experience installing joint sealants similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

C. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

D. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Use manufacturer's standard test method to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Submit not fewer than required by sealant manufacturer for testing for each kind of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.
5. Testing will not be required if joint-sealant manufacturers submit data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, staining of, and compatibility with joint substrates and other materials matching those submitted.

B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:

1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
2. Conduct field tests for each kind of sealant and joint substrate.
3. Notify Architect seven days in advance of dates and times when test joints will be erected.
4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.

    a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

        1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.
7. Field testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

1.8 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer. In no event shall sealants be installed when substrate and ambient temperatures are below 60 deg F or are above 85 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.9 WARRANTY

A. Special Manufacturer's Warranty: Manufacturer’s standard or customized material and labor form in which manufacturer agrees to repair or replace joint sealants that do not comply with requirements or that fail to stop the passage of air and/or water within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

B. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with requirements or that fail to stop the passage of air and/or water within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

C. Defects, faulty work, and failures include, but are not limited to the following:

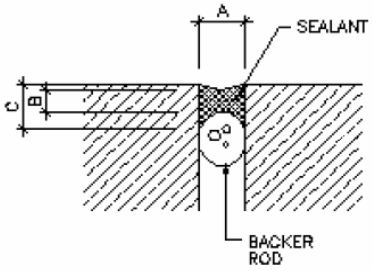
1. Adhesive or cohesive failure of sealant.
2. Abrasion-resistance failure.
3. Lack of resistance to migration.
4. Staining of substrates from sealant or primers.
5. Durability of specified performance.
6. Failure to maintain continuous airtight and watertight seal.
7. Crazing on outside of non-structural sealant.
8. Non-structural sealant hardening beyond Shore A durometer 50 or softening below 20.

D. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS



1. Dimension A shall be at least 1/4 inch.
2. Dimension B shall be at least 1/8 inch.
3. Dimension C shall be at least 1/4 inch.
4. Ratio of dimension A to dimension B shall be 2:1 minimum.
5. Joint surface shall be tooled.
6. Dimension B shall not exceed 1/2 inch.
7. Dimension A shall not exceed 1 inch.
8. Joints with Dimension A in excess of 1 inch shall:
   a. Implement another jointing system as recommended by the substrate material manufacturer that does not require the use of a sealant joint over 1 inch in width.

2.2 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint sealant manufacturer, based on testing and field experience.

B. Sustainable Design Requirements: Joint sealants, sealant primers, and caulks shall comply with the following:

1. Architectural sealants shall have a VOC content of 250 g/L or less.
2. Sealants and sealant primers for nonporous substrates shall have a VOC content of 250 g/L or less.
3. Sealants and sealant primers for porous substrates shall have a VOC content of 775 g/L or less.

C. Stain-Test-Response Characteristics: At porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

D. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

E. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.3 SILICONE JOINT SEALANTS

A. SJ-1: Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT

1. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

a. Dow Corning Corporation; 790.
b. Or Comparable Equal.

B. SJ-2: Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 50, for Use NT.

1. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

a. Dow Corning Corporation; 795.
b. Or Comparable Equal.

C. SJ-3: Neutral, one-part silicone sealant, designed for adhering to low energy surfaces common in sheet or peel-and-stick weather-resistant barriers: ASTM C 920, Type S, Grade NS, Class 25.

1. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

a. Dow Corning Corporation, 758.

D. SJ-4: Silicone, Non-staining, S, NS, 50, NT: Non-staining, single-component, non-sag, plus 50 percent and minus 50 percent movement capability, non-traffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT, with no staining of substrates when tested according to ASTM C 1248.

1. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

a. Dow Corning Corporation; 756 SMS.

2.4 MILDEW-RESISTANT JOINT SEALANTS

A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

B. MRJ-1: Mildew-Resistant, Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.

1. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

a. Pecora Corporation; 898 NST.
b. Or Comparable Equal.

2.5 URETHANE JOINT SEALANTS

A. UJ-1: Single-Component, Nonsag, Urethane Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.

1. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

a. BASF Building Systems; MasterSeal NP1.
b. Or Comparable Equal.

2.6 LATEX JOINT SEALANTS

A. LJ-1: Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

1. Subject to compliance with requirements, provide one of the following:

a. Pecora Corporation; AC-20+.
b. Or Comparable Equal.

2.7 ACOUSTICAL JOINT SEALANTS

A. AJ-1: Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining acrylic sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

1. Basis of Design Product: Subject to compliance with requirements, provide the following:

a. USG Corporation; SHEETROCK Acoustical Sealant.
b. Or Comparable Equal.

2.8 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.9 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

    a. Concrete.
    b. Masonry.
    c. Unglazed surfaces of ceramic tile.

3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

    a. Metal.
    b. Glass.
    c. Porcelain enamel.
    d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.
4. Provide flush joint profile where indicated according to Figure 8B in ASTM C 1193.
5. Provide recessed joint configuration of recess depth and at locations indicated according to Figure 8C in ASTM C 1193.

    a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

G. Acoustical Sealant Installation: At sound-rated assemblies, at all full-height walls/partitions, and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919, ASTM C 1193, and with manufacturer's written recommendations for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slab and above acoustical ceilings.

H. Acoustical Ceiling Areas: Apply acoustical joint sealant at perimeter edge of molding of acoustical ceiling areas in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as required by manufacturer to obtain warranty specified.
2. Test Method: Test joint sealants according to manufacturer’s written instructions and latest industry standard test method per ASTM C 1193 or ASTM C 1521.

    a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

3. Inspect tested joints and report on the following:

    a. Whether sealants filled joint cavities and are free of voids.
    b. Whether sealant dimensions and configurations comply with specified requirements.
    c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.

4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT SEALANT SCHEDULE

A. Exterior joints in horizontal traffic surfaces.

1. Urethane Joint Sealant: UJ-1.

a. Joint Locations:
1) Isolation and contraction joints in cast-in-place concrete slabs.
2) Joints in stone paving units.
3) Tile control and expansion joints.
4) Joints between different materials listed above.
5) Other joints as indicated.

B. Exterior joints in vertical surfaces and horizontal nontraffic surfaces:

1. Silicone Joint Sealant: SJ-1

a. Joint Locations:
1) Construction joints in cast-in-place concrete.
2) Control and expansion joints in concrete unit masonry.

2. Silicone Joint Sealant: SJ-2.

a. Joint Locations:
1) Perimeter joints of exterior openings at frames of doors, windows, and louvers.
2) Control and expansion joints in ceilings and other overhead surfaces.
3) Joints between metal panels.
4) Joints between different materials listed above.
5) Other joints as indicated.

3. Silicone Joint Sealant: SJ-3.

a. Joint Locations:
1) Where in direct contact with fluid-applied, sheet, or peel-and-stick weather-resistant barriers,

4. Silicone Joint Sealant: SJ-4.

a. Joint Locations:
1) Stone, sensitive porous or cementitious substrates subject to staining, metal substrates subject to residue rundown, and where indicated.

C. Interior joints in horizontal traffic surfaces:

1. Urethane Joint Sealant: UJ-1.

a. Joint Locations:
1) Isolation joints in cast-in-place concrete slabs.
2) Control and expansion joints in stone flooring.
3) Control and expansion joints in tile flooring.
4) Other joints as indicated.

D. Interior joints in vertical surfaces in horizontal nontraffic surfaces:

1. Latex Joint Sealant: LJ-1.

a. Joint Locations:
1) Control and expansion joints on exposed interior surfaces of exterior walls.
2) Perimeter joints on interior side of exterior openings where indicated.
3) Tile control and expansion joints.
4) Vertical joints on exposed surfaces of interior unit masonry, concrete walls, and partitions.
5) Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.
6) Other joints as indicated.

E. Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Mildew-Resistant Joint Sealant: MRJ-1.

a. Joint Locations:
1) Joints between plumbing fixtures and adjoining walls, floors, and counters.
2) Joints between locker room lockers and adjacent materials.
3) Other interior joints in wet areas where needed to limit mold and mildew growth.
4) Other joints as indicated.

F. Interior acoustical joints in vertical surfaces and horizontal nontraffic surfaces.

1. Acoustical Joint Sealant: AJ-1.

a. Joint Location:
1) Joints and penetrations in gypsum board surfaces.
2) Other joints as indicated.

END OF SECTION 079200

SECTION 079513 - EXTERIOR EXPANSION JOINT COVER ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes exterior building expansion joint cover assemblies.

B. Related Requirements:

1. Section 033000 "Cast-In-Place Concrete" for cast-in exterior expansion joint frames furnished, but not installed, in this Section.
2. Section 076200 "Sheet Metal Flashing and Trim" for sheet metal flashing to the extent not provided as part of this Section.
3. Section 079100 "Preformed Joint Seals" for preformed foam and extruded-silicone joint seals.

1.3 DEFINITIONS

A. Maximum Joint Width: Widest linear gap a joint system tolerates and in which it performs its designed function without damaging its functional capabilities.

B. Minimum Joint Width: Narrowest linear gap a joint system tolerates and in which it performs its designed function without damaging its functional capabilities.

C. Movement Capability: Value obtained from the difference between widest and narrowest widths of a joint.

D. Nominal Joint Width: The width of the linear opening specified in practice and in which the joint system is installed.

1.4 COORDINATION

A. Coordinate installation of exterior expansion joint cover assemblies that are anchored to other work. Furnish setting drawings, templates, and directions for installing anchorages that are to be embedded in concrete. Deliver such items to Project site in time for installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for expansion joint cover assemblies.

B. Shop Drawings: Provide project-specific shop drawings for each expansion joint cover assembly.

1. Include plans, elevations, sections, details, splices, block-out requirement, attachments to other work, and line diagrams showing entire route of each expansion joint.
2. Where expansion joint cover assemblies change planes, provide isometric or clearly detailed drawing depicting how components interconnect.

C. Samples for Verification: For each type of expansion joint cover assembly, full width by 6 inches long in size.

D. Expansion Joint Cover Assembly Schedule: Prepared by or under the supervision of the supplier. Include the following information in tabular form:

1. Manufacturer and model number for each expansion joint cover assembly.
2. Expansion joint cover assembly location cross-referenced to Drawings.
3. Nominal, minimum, and maximum joint width.
4. Movement direction.
5. Materials, colors, and finishes.
6. Product options.
7. Fire-resistance ratings.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Product Test Reports: For each joint cover assembly, for tests performed by a qualified testing agency.

C. Warranties: For special warranties.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of exterior expansion joint cover assemblies that have been used for similar applications with successful results, that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports and calculations. Manufacturer shall have factory-authorized service representatives who are available for consultation, periodic Project-site observations, and on-site assistance.

B. Installer Qualifications: A firm with not less than 5 years' experience installing exterior expansion joint cover assemblies similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

1.8 PROJECT CONDITIONS

A. Do not proceed with installation of expansion control systems under the following conditions:

a. When ambient and substrate temperatures conditions are outside limits permitted by expansion control system manufacturer.
b. When joint substrates are wet.
c. When joint widths are less than those allowed by expansion control manufacturer for applications indicated.
d. Where contaminants capable of interfering with installation have not yet been removed from joint substrates.

1.9 WARRANTY

A. Special Warranty for Exterior Expansion Control Systems: Manufacturer's standard or customized warranty in which manufacturer and installer agree to repair or replace expansion control systems that do not comply with performance requirements and/or fail to stop the passage of water within specified warranty period.

1. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide exterior expansion joint cover assemblies by the following:

1. CS-Group, Inc. See below for specific models.

B. Source Limitations: Obtain exterior expansion joint cover assemblies from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General: Expansion control systems shall resist the movement indicated without failure, rattling, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction. In addition to the above requirements, exterior joints shall also withstand exposure to weather, and remain watertight without leaking.

B. Seismic Performance: Expansion joint cover assemblies shall withstand the effects of earthquake motions determined according to the 2016 California Building Code (CBC) and ASCE/SEI 7.

1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified. The system shall remain fully operational after elastic seismic events."
2. Component Importance Factor is per the 2016 CBC.

C. Story Drift: Accommodate design displacement of adjacent stories indicated.

1. Amplified (Inelastic) Story Drift Displacement: As indicated on Structural Drawings.

a. The expansion control system may experience localized material failures, sealant may tear, framing elements may warp and buckle, however no anchor shall fail nor shall any portion of the expansion control system experience catastrophic failure by falling from the building.

2. Elastic Story Drift Displacement: As indicated on Structural Drawings.

a. The expansion control system shall not experience any failure in materials, sealants, anchorage of any kind. The expansion control system shall remain fully operational. Exterior expansion control systems shall remain air and water tight.
b. Floor-to-floor seismic cover assemblies:

1) Shall include concealed lifting device to allow full elastic movement without damage to cover. Center plate shall be held in place and kept centered throughout movement cycle.
2) Shall accommodate wind elastic drift displacements with no vertical movement of lifting device.

3. Expansion Joint Design Criteria:

a. Type of Movement: Seismic.

1) Nominal Joint Width: As indicated on Drawings.
2) Maximum Joint Width: As indicated on Drawings.
3) Minimum Joint Width: As indicated on Drawings.
4) Lateral Shear Movement Capability: As indicated on Drawings.

D. Fire-Resistance Ratings: Provide expansion control systems with fire barriers identical to those of systems tested for fire resistance per UL 2079 or ASTM E 1966 by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Match fire-resistance rating of floor or wall assembly into which expansion control system is being installed.

E. Accessibility Requirements: Comply with the 2010 ADA Standards for Accessible Design and the accessibility requirements of the 2016 CBC.

1. Bevel raised floor covers with a slope of not more than 1:2. Provide floor covers not more than 1/2 inch high.

F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.3 ASSEMBLY DESCRIPTION

A. Furnish units in longest practicable lengths to minimize field splicing.

B. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion joint cover assemblies.

2.4 EXTERIOR EXPANSION JOINT COVERS

A. Exterior Metal-Plate Joint Cover: Assembly consisting of self-centering stainless steel center plate that remains flush during thermal and wind movement events, but temporarily displaces and slides over floor surface during seismic movement.

1. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

a. CS-Group, Inc. Models SJ-HD-S and SJW-HD-S Series (stainless steel finish).

2. Application: Floor-to-floor and floor-to-wall.
3. Installation: Recessed, cast into adjacent concrete.
4. Type of Movement: Seismic; refer to performance requirements above.
5. Fire-Resistance Rating: Not less than of adjacent construction.
6. Moisture Barrier: Manufacturer's standard moisture barrier consisting of a continuous, waterproof membrane within joint and attached to substrate on sides of joint below the primary cover.

a. Drain-Tube Assemblies: Equip moisture barrier with drain tubes and seals to direct collected moisture to drain to nearest plumbing drain assembly.

7. Exposed Metal:

a. Directional textured finish, slip resistant.

2.5 MATERIALS

A. Aluminum: ASTM B 221, Alloy 6063-T5 for extrusions; ASTM B 209, Alloy 6061-T6 for sheet and plate.

1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.

B. Stainless Steel: ASTM A 240 or ASTM A 666, Type 304 for plates, sheet, and strips.

C. Elastomeric Seals: Manufacturer's standard preformed elastomeric membranes or extrusions to be installed in metal frames.

D. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint and to meet performance criteria for required fire-resistance rating.

E. Moisture Barrier: Flexible elastomeric material, PVC, minimum 30 mils thick; Santoprene.

F. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

G. Accessories: Manufacturer's stainless-steel attachment devices. Include anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

2.6 ALUMINUM FINISHES

A. Mill finish.

2.7 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
3. Directional Satin Finish: No. 4.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces where expansion joint cover assemblies will be installed for installation tolerances and other conditions affecting performance of the Work.

B. Notify Architect where discrepancies occur that will affect proper expansion joint cover assembly installation and performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to expansion joint cover assembly manufacturer's written instructions.

B. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion joint cover assemblies. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of expansion joint cover assemblies.

3.3 INSTALLATION

A. Comply with manufacturer's written instructions for storing, handling, and installing expansion joint cover assemblies and materials unless more stringent requirements are indicated.

B. Metal Frames: Perform cutting, drilling, and fitting required to install expansion joint cover assemblies.

1. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
2. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation.
3. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
4. Install frames in continuous contact with adjacent surfaces.

a. Shimming is not permitted.

5. Locate anchors at interval recommended by manufacturer, but not less than 3 inches from each end and not more than 24 inches o.c.

C. Seals: Install elastomeric seals and membranes in frames to comply with manufacturer's written instructions. Install with minimum number of end joints.

1. Provide in continuous lengths for straight sections.
2. Seal transitions. Vulcanize or heat-weld field-spliced joints as recommended by manufacturer.
3. Installation: Mechanically lock seals into frames or adhere to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.

D. Install with hairline mitered corners where expansion joint cover assemblies change direction or abut other materials.

E. Terminate exposed ends of expansion joint cover assemblies with field- or factory-fabricated termination devices.

F. Fire-Resistance-Rated Assemblies: Coordinate installation of expansion joint cover assembly materials and associated work so complete assemblies comply with performance requirements.

1. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.

G. Moisture Barrier Drainage: If indicated, provide drainage fitting and connect to drains.

3.4 PROTECTION

A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.

B. Protect the installation from damage by work of other Sections.

1. Where necessary due to heavy construction traffic, remove and properly store cover plates or seals and install temporary protection over expansion control systems. Reinstall cover plates or seals prior to Substantial Completion of the Work.

END OF SECTION 079513

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes hollow-metal work.

B. Related Requirements:

1. Section 042200 "Concrete Unit Masonry" for embedding anchors for hollow metal work into concrete unit masonry.
2. Section 081416 "Flush Wood Doors" for wood doors to receive hollow metal frames.
3. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.
4. Section 088000 "Glazing" for glass within borrowed lites and doors.
5. Sections 099113 "Exterior Painting" and 099123 "Interior Painting" for field painting hollow metal doors and frames.
6. Division 26 Section(s) for electrical connections including conduit and wiring for door controls and operators.
7. Division 28 Section(s) for low voltage connections, including conduit and wiring for door contacts and controls for intrusion detection.

1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.4 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.
9. Details of conduit and preparations for power, signal, and control systems.

C. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of hollow metal doors and frames that have been used for similar applications with successful results, that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports and labels. Manufacturer shall also be a member of the Steel Door Institute.

B. Installer Qualifications: A firm with not less than 10 years' experience installing hollow metal doors and frames similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ceco Door; ASSA ABLOY.
2. Curries Company; ASSA ABLOY.
3. Security Metal Products; ASSA ABLOY.
4. Or Comparable Equal, subject to compliance with Quality Assurance article above and with Section 016000 "Product Requirements."

B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

B. Fire-Rated, Borrowed-Lite Assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.3 INTERIOR DOORS AND FRAMES

A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Maximum-Duty Doors and Frames: SDI A250.8, Level 4; SDI A250.4, Level A.

1. Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches
c. Face: Cold-rolled steel sheet, minimum thickness of 0.067 inch, metallic-coated at wet locations with minimum A40 coating.
d. Edge Construction: Model 2, Seamless.
e. Core: Vertical steel stiffener with UL-listed fire door core board, complying with manufacturer's tested assembly.

2. Frames:

a. Materials: Steel sheet, minimum thickness of 0.067 inch, metallic-coated at wet locations with minimum A40 coating.
b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
c. Construction: Full profile welded.

3. Exposed Finish: Prime.

2.4 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Maximum-Duty Doors and Frames: SDI A250.8, Level 4; SDI A250.4, Level A.

1. Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches.
c. Face: Metallic-coated steel sheet, minimum thickness of 0.067 inch, with minimum A40 coating.
d. Edge Construction: Model 2, Seamless.
e. Core: Vertical steel stiffener with minimum 0.75 lb density insulation between stiffeners.

1) Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 1.5 when tested according to ASTM C 1363.

2. Frames:

a. Materials: Metallic-coated steel sheet, minimum thickness of 0.067 inch, with minimum A40 coating.
b. Construction: Full profile welded.

3. Exposed Finish: Prime.

2.5 BORROWED LITES

A. Hollow-metal frames of steel sheet, minimum thickness of 0.053 inch, with minimum A40 metallic coating at exterior and wet interior locations.

B. Construction: Full profile welded.

C. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as metal as frames.

D. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

2.6 FRAME ANCHORS

A. Jamb Anchors:

1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet.
3. Postinstalled Expansion Anchor: Minimum 3/8-inch-diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at top of underlayment.

D. Material: ASTM A 879, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008 or ASTM A 1011; hot-dip galvanized according to ASTM A 153, Class B.

2.7 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A 653, Commercial Steel (CS), Type B.

D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153.

E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

F. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143.

G. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

H. Glazing: Comply with requirements in Section 088000 "Glazing."

2.8 FABRICATION

A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.

1. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

D. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with mitered hairline joints.

1. Provide stops and moldings flush with face of door, and with square stops unless otherwise indicated.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
5. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

2.9 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.10 LOUVERS

A. Provide louvers for interior doors, where indicated, which comply with SDI 111, with blades or baffles formed of 0.020-inch-thick, cold-rolled steel sheet set into 0.032-inch-thick steel frame.

1. Exterior Louvers: Storm-resistant, sightproof, and drainable.
2. Interior Louvers: Sightproof louvers constructed with inverted-V or inverted-Y blades.
3. Fire-Rated Automatic Louvers: Louvers constructed with movable blades closed by actuating fusible link, and listed and labeled for use in fire-rated door assemblies of type and fire-resistance rating indicated by same qualified testing and inspecting agency that established fire-resistance rating of door assembly.

B. Form corners of moldings with hairline joints. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.

1. Hollow metal doors and frames shall be properly installed such that without closer attached, door opening force is 1 lbf or less.

B. Hollow-Metal Frames: Install hollow-metal frames for doors, transoms, sidelites, borrowed lites, and other openings, of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.

    a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
    b. Install frames with removable stops located on secure side of opening.

2. Fire-Rated Openings: Install frames according to NFPA 80.
3. Floor Anchors: Secure with postinstalled expansion anchors.

    a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

4. Solidly pack mineral-fiber insulation inside frames.
5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
7. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:

    a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Steel Doors: Comply with SDI A250.8.

a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors and gaskets according to NFPA 105.

D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.4 ADJUSTING AND CLEANING

A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 081113

SECTION 081216 - ALUMINUM FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes interior aluminum frames for doors installed in gypsum board partitions.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles,and finishes.

B. Shop Drawings: For aluminum frames:

1. Include elevations, sections, and installation details for each wall-opening condition.
2. Include details for each frame type, including dimensioned profiles and metal thicknesses.
3. Include locations of reinforcements and preparations for hardware.
4. Include details of anchorages, joints, field splices, connections, and accessories.

C. Samples for Verification: For each type of the following products:

1. Framing Member and Finish: 12 inches long. Include trim.
2. Corner Fabrication and Finish: 12-by-12-inch-long, full-size window corner, including full-size sections of extrusions with factory-applied color finish.

D. Product Schedule: For aluminum frames. Use same designations indicated on Drawings. Coordinate with door hardware schedule.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of aluminum frames that have been used for similar applications with successful results, that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports and labels. Manufacturer shall also be a member of the Steel Door Institute.

B. Installer Qualifications: A firm with not less than 10 years' experience installing aluminum frames similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For aluminum frames to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

1. Fry Reglet Corporation; "Minimalist" aluminum door frames.

B. Source Limitations: Obtain aluminum frames from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Test Procedures and Performance: Provide independent lab test report based on ANSI/SDI A250.4 Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, and Frame Anchors indicating that frame has been tested and achieved a count of at least 35,000 cycles when subjected to a shutting force of 7 pounds per cycle, showing no visible cracking in abutting drywall finishing.

2.3 COMPONENTS

A. Aluminum Framing: ASTM B 221, with alloy and temper required to suit structural and finish requirements, and not less than 0.078 inch thick.

B. Door Frames: Extruded aluminum, reinforced for hinges, strikes, and closers.

C. Construction: Extruded aluminum hinge jamb, strike jamb and header section factory mitered to install with hair-line seams.

D. Provide continuous door silencer of Thermoplastic Vulcanizate (TPV) material.

E. Frame sections shall be extruded to include continuous, punched, taping flanges along each exposed section for application of tape, mid, primer, and paint.

F. Hardware Installation: Hinge jamb to be factory assembled with concealed hinges.

G. Reinforcements: Include integral hinge and strike reinforcements designed to position hinge and strike plates flush with face of frame.

H. Frame and Trim Finish: Factory-applied, baked-enamel or powder-coat finish.

1. Color: As indicated on Drawings, or if not indicated, in custom color to match Architect's sample.

2.4 ACCESSORIES

A. Fasteners: Aluminum, nonmagnetic, stainless-steel or other noncorrosive metal fasteners compatible with frames, stops, panels, reinforcement plates, hardware, anchors, and other items being fastened.

B. Door Hardware: As specified in Section 087100 "Door Hardware."

2.5 FABRICATION

A. Provide concealed corner reinforcements and alignment clips for accurately fitted hairline joints at butted and mitered connections.

B. Factory prepare aluminum frames to receive templated mortised hardware; include cutouts, reinforcements, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in Section 087100 "Door Hardware."

C. Fabricate components to allow secure installation without exposed fasteners.

2.6 GENERAL FINISH REQUIREMENTS

A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 ALUMINUM FINISHES

A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify that wall thickness does not exceed standard tolerances allowed by throat size of indicated aluminum frame.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install aluminum frames plumb, rigid, properly aligned, and securely fastened in place; according to manufacturer's written instructions.

1. Doors and aluminum frames shall be properly installed such that without closer attached, door opening force is 1 lbf or less.

B. Install frame components in the longest possible lengths with no piece less than 48 inches; components 96 inches or shorter shall be one piece.

1. Use concealed installation clips to produce tightly fitted and aligned splices and connections.
2. Secure clips to extruded main-frame components and not to snap-in or trim members.
3. Do not leave screws or other fasteners exposed to view when installation is complete.

C. Doors: Install doors aligned with frames and fitted with required hardware.

D. Door Hardware: Install according to Section 087100 "Door Hardware" and aluminum-frame manufacturer's written instructions.

3.3 ADJUSTING

A. Inspect installation, correct misalignments, and tighten loose connections.

B. Doors: Adjust doors to operate smoothly and easily, without binding or warping. Adjust hardware to function smoothly, and lubricate as recommended by manufacturer.

C. Clean exposed frame surfaces promptly after installation, using cleaning methods recommended in writing by frame manufacturer and according to AAMA 609 & 610.

D. Touch Up: Repair marred frame surfaces to blend inconspicuously with adjacent unrepaired surface so touchup is not visible from a distance of 48 inches as viewed by Architect. Remove and replace frames with damaged finish that cannot be satisfactorily repaired.

END OF SECTION 081216

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Interior solid-core doors with wood-veneer faces.
2. Factory finishing flush wood doors.
3. Fitting wood doors to frames and factory machining for hardware.

B. Related Requirements:

1. Section 081113 “Hollow Metal Doors and Frames” for hollow metal frames for wood doors.
2. Section 081433 “Stile and Rail Wood Doors” for requirements from the same flitches for both flush wood doors and stile and rail wood doors.
3. Section 087100 "Door Hardware" for door hardware for wood doors.
4. Section 088000 “Glazing” for glass view panels in flush wood doors.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct at Project site

1.4 ACTION SUBMITTALS

A. Product Data: For each type of door indicated. Include details of core and edge construction, and trim for openings. Include factory-finishing specifications.

B. Sustainable Design Submittals: Product data for adhesives, composite wood products, and stains documenting that products comply with sustainable design performance requirements.

C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:

1. Dimensions and locations of blocking.
2. Dimensions and locations of mortises and holes for hardware.
3. Dimensions and locations of cutouts.
4. Undercuts.
5. Requirements for veneer matching.
6. Doors to be factory finished and finish requirements.
7. Fire-protection ratings for fire-rated doors.

D. Samples for Initial Selection: For factory-finished doors.

E. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. Provide set of three samples showing typical range of color and grain to be expected in the finished work.
2. Frames for light openings, 6 inches long, for each material, type, and finish required.
3. Corner sections of doors, approximately 8 by 10 inches, with door faces and edges representing actual materials to be used.

a. Finish veneer-faced door samples with same materials proposed for factory-finished doors.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Product Test Reports: For each type of fire-resistant rated and/or STC-rated flush wood door assembly, for tests performed by a qualified testing agency.

C. Sample Warranty: For special warranty.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of flush wood doors that have been used for similar applications with successful results, that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports and labels. Manufacturer shall also be qualified to produce doors that meet the current WDMA I.S. 1A Industry Standard for Architectural Wood Flush Doors.

B. Installer Qualifications: A firm with not less than 10 years' experience installing flush wood doors similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in plastic bags or cardboard cartons.

C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1. Doors shall be allowed to reach average prevailing temperature and humidity conditions within the area of installation for not less than 48 hours prior to installation.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.

2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
3. Warranty Period for Solid-Core Interior Wood Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide flush wood door products by one of the following:

1. Graham Wood Doors; ASSA ABLOY.
2. Oregon Door.
3. VT Industries, Inc.

B. Source Limitations: Obtain flush wood doors from single manufacturer.

2.2 FLUSH WOOD DOORS, GENERAL

A. Quality Standard: In addition to requirements specified, comply with WDMA I.S. 1A, “Architectural Wood Flush Doors.”

1. Contract Documents may contain selections chosen from options in quality standard and additional requirements beyond those of quality standard. Comply with those selections and requirements in addition to quality standard.

B. Sustainable Design Requirements: Adhesives and composite wood products shall comply with 2016 CALGreen mandatory measures:

1. Adhesives: Adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers and caulks shall comply with local or regional air pollution control or air quality management district rules where applicable, or SCAQMD Rule 1168 VOC limits, as shown in 2016 CALGreen Tables 5.504.4.1 and 5.504.4.2. Such products also shall comply with the Rule 1168 prohibition on the use of certain toxic compounds (chloroform, ethylene dichloride methylene chloride, perchloroethylene and trichloroethylene). Adhesives shall have no added formaldehyde resins.
2. Composite Wood Products: Hardwood plywood, particleboard and medium density fiberboard composite wood products used on the interior or exterior of the building shall meet the requirements for formaldehyde as specified in ARB's Air Toxics Control Measure (ATCM) for Composite Wood (17 CCR 93120 et seq.) Those materials not exempted under the ATCM must meet the specified emission limits, as shown in 2016 CALGreen Table 5.504.4.5.

C. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.

D. Fire-Rated Wood Doors (Greater than 20-minute fire rating): Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Cores: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
2. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
3. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
4. Blocking: Provide composite blocks with improved screw-holding capability approved for use in doors of fire-protection ratings indicated and as needed to eliminate thought-bolting hardware.

E. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control, based on testing according to UL 1784.

F. Non-Fire-Rated and 20-Minute-Rated Wood Doors:

1. Structural Composite Lumber: Solid structural composite lumber core conforming to WDMA I.S.10 and containing no urea-formaldehyde resin.

a. Screw Withdrawal, Face: 700 lbf.
b. Screw Withdrawal, Edge: 400 lbf.

G. Fire-Rated Doors (Greater than 20 Minutes):

1. Mineral-Core Doors:

a. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
b. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated as needed to eliminate through-bolting hardware.

2. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

a. Screw-Holding Capability: Per WDMA T.M.-10.

2.3 VENEERED-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Flush Solid-Core Doors:

1. Grade: Premium, with Grade A faces.
2. Species: As indicated on Drawings.
3. Cut: As indicated on Drawings, or if not indicated, quarter sliced.
4. Match Between Veneer Leaves: Book.
5. Assembly of Veneer Leaves on Door Faces: Center-balance.
6. Pair and Set Match: Provide for doors hung in same opening.
7. Room Match: Match door faces within each separate room or area of building.
8. Exposed Vertical Edges: Same species as faces, edge Type A.
9. Construction: Five plies. Stiles and rails are bonded to core, then entire unit abrasive planed before veneering.
10. Thickness: 1-3/4 inches.
11. Custom Transparent Finish: Match Architect’s sample.
12. Core:

a. Solid Structural Composite Lumber: Non-fire-rated and 20-minute-rated doors.
b. Mineral Core: Fire-rated doors with a fire rating greater than 20 minutes.

2.4 LIGHT FRAMES

A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.

1. Wood Species: Same species as door faces.
2. Profile: Flush rectangular beads.
3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.

B. Wood-Veneered Beads for Light Openings in Fire-Rated Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire-protection rating indicated. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.

2.5 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

1. Comply with requirements in NFPA 80 for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.

1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.

C. Side Panels: Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles.

1. Fabricate door and side light panels with full-width, solid-lumber, rabbeted**,** meeting rails. Provide factory-installed spring bolts for concealed attachment into jambs of metal door frames.

D. Openings: Factory cut and trim opening though doors.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 “Glazing.”

2.6 FACTORY FINISHING

A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.

1. Finish faces, all four edges, edges of cutouts, and mortises. Fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.

B. Factory finish doors.

C. Transparent Finish:

1. Grade: Premium.
1. Finish: WDMA TR-6, catalyzed polyurethane.
2. Staining: Custom to match Architect’s sample.
3. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames before hanging doors.

1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install flush wood doors level, plumb, square, true to line; without distortion, warp, or rack, and without impeding movement; anchored securely in place. Comply with Drawings and manufacturer's written instructions.

1. Flush wood doors shall be properly installed such that without closer attached, door opening force is 1 lbf or less.

B. Hardware: For installation, see Section 087100 "Door Hardware."

C. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.

1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.
2. Install smoke- and draft-control doors according to NFPA 105.

D. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.

1. Clearances: Provide 1/8 inch at heads, jambs, and between pairs of doors. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.

a. Comply with NFPA 80 for fire-rated doors.

2. Bevel non-fire rate doors 1/8 inch in 2 inches at lock and hinge edges.
3. Bevel fire-rated doors 1/8 inch in 2 inches at lock edge; trim stiles and rails only to extent permitted by labeling agency.

E. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

F. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

C. Adjust door hinges to provide uniform clearances at heads, jambs, and floor as indicated below and to contact frame silencers or stops uniformly. Perform these alterations only if doors are not factory pre-fit and pre-machined, or not fire-rated.

1. Fit doors to width by planning equally from both sides.
2. Bevel lock and hinge edges 1/8-inch in 2 inches.
3. Side and top clearance: 1/8-inch.
4. Floor clearance: 3/4-inch.

D. Re-adjust door heights after carpet installation.

END OF SECTION 081416

SECTION 081433 - STILE AND RAIL WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Interior stile and rail wood doors with wood-veneer faces.
2. Factory finishing of stile and rail wood doors.
3. Fitting stile and rail wood doors to frames and factory machining for hardware.

B. Related Requirements:

1. Section 081113 "Hollow Metal Doors and Frames" for hollow metal frames for stile and rail wood doors.
2. Section 081416 "Flush Wood Doors" for requirements for veneers from the same flitches for both flush wood doors and stile and rail wood doors.
3. Section 087100 "Door Hardware" for door hardware to be installed in stile and rail wood doors.
4. Section 088000 "Glazing" for glazing to be installed in stile and rail wood doors.

1.3 PREINSTALLATION MEETING

A. Preinstallation Conference: Conduct at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include details of construction.
2. Include factory-finishing specifications.

B. Sustainable Design Submittals: Product data for adhesives, composite wood products, and stains documenting that products comply with sustainable design performance requirements.

C. Shop Drawings: For stile and rail wood doors. Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data, including those for stiles, rails, panels, and moldings (sticking); and other pertinent data, including the following:

1. Dimensions and locations of blocking.
2. Dimensions and locations of mortises and holes for hardware.
3. Dimensions and locations of cutouts.
4. Undercuts.
5. Requirements for veneer matching.
6. Doors to be factory finished and finish requirements.
7. Fire-protection ratings for fire-rated doors.

D. Samples for Initial Selection: For factory-finished doors.

E. Samples for Verification: Corner sections of doors, approximately 8 by 10 inches, with door faces and edgings representing typical range of color and grain for each species of veneer and solid lumber required. Finish Sample with same materials proposed for factory-finished doors.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Sample Warranty: For special warranty.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of stile and rail wood doors that have been used for similar applications with successful results, that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports and labels. Manufacturer shall also meet the current WDMA I.S. 1A Industry Standard for Wood Stile and Rail Doors.

B. Installer Qualifications: A firm with not less than 10 years' experience installing stile and rail wood doors similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in opaque plastic bags or cardboard cartons.

C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during remainder of construction period.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.

2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
3. Warranty Period for Solid-Core Interior Stile and Rail Wood Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide products by the following:

1. Eggers Industries.

Or a comparable product by one of the following, subject to compliance with requirements herein and with Section 016000 "Product Requirements:"

2. Algoma Hardwoods, Inc.
3. Marshfield Door Systems, Inc.

B. Source Limitations: Obtain stile and rail wood doors from single manufacturer.

2.2 STILE AND RAIL WOOD DOORS, GENERAL

A. Quality Standard: In addition to requirements specified, comply with WDMA I.S.6, "Industry Standard for Wood Stile and Rail Doors," and with other requirements specified.

1. The Contract Documents may contain selections chosen from options in quality standard and additional requirements beyond those of quality standard. Comply with those selections and requirements in addition to quality standard.
2. Assemble interior doors, including components, with either dry-use or wet-use adhesives complying with ASTM D 5572 for finger joints and with ASTM D 5751 for joints other than finger joints.

B. Sustainable Design Requirements: Adhesives and composite wood products shall comply with 2016 CALGreen mandatory measures:

1. Adhesives: Adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers and caulks shall comply with local or regional air pollution control or air quality management district rules where applicable, or SCAQMD Rule 1168 VOC limits, as shown in 2016 CALGreen Tables 5.504.4.1 and 5.504.4.2. Such products also shall comply with the Rule 1168 prohibition on the use of certain toxic compounds (chloroform, ethylene dichloride methylene chloride, perchloroethylene and trichloroethylene). Adhesives shall have no added formaldehyde resins.
2. Composite Wood Products: Hardwood plywood, particleboard and medium density fiberboard composite wood products used on the interior or exterior of the building shall meet the requirements for formaldehyde as specified in ARB's Air Toxics Control Measure (ATCM) for Composite Wood (17 CCR 93120 et seq.) Those materials not exempted under the ATCM must meet the specified emission limits, as shown in 2016 CALGreen Table 5.504.4.5.

C. Panel Products: Any of the following unless otherwise indicated:

1. Medium-density fiberboard made from wood fiber, with binder containing no urea-formaldehyde, complying with ANSI A208.2, Grade 130.
2. Hardboard complying with ANSI A135.4.
3. Veneer-core plywood, made with adhesive containing no urea-formaldehyde.

D. Fire-Rated Wood Doors (Greater than 20-minute fire rating): Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Cores: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
2. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
3. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
4. Blocking: Provide composite blocks with improved screw-holding capability approved for use in doors of fire-protection ratings indicated and as needed to eliminate thought-bolting hardware.

E. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control, based on testing according to UL 1784.

F. Non-Fire-Rated and 20-Minute-Rated Wood Doors:

1. Structural Composite Lumber: Solid structural composite lumber core conforming to WDMA I.S.10 and containing no urea-formaldehyde resin.

a. Screw Withdrawal, Face: 700 lbf.
b. Screw Withdrawal, Edge: 400 lbf.

G. Safety Glass: Provide products complying with testing requirements in 16 CFR 1201, for Category II materials, unless those of Category I are expressly indicated and permitted.

2.3 INTERIOR STILE AND RAIL WOOD DOORS

A. Interior Stile and Rail Wood Doors: Interior doors complying with WDMA I.S.6, "Industry Standard for Wood Stile and Rail Doors," and with other requirements specified.

1. Panel Designs: Indicated on Drawings. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
2. Grade: Premium.
3. Finish: Transparent.
4. Wood Species and Cut: As indicated on Drawings, or if not indicated, matching same species and cut as indicated in Section 081416 “Flush Wood Doors.”
5. Door Construction for Transparent Finish:

    a. Stile and Rail Construction: Veneered, structural composite lumber. Select veneers for similarity of grain and color, and arrange for optimum match between adjacent pieces. Use veneers not less than 1/16 inch thick.

6. Stile and Rail Widths: As indicated on Drawings, with bottom rail no less than 10 inches.
7. Stile and Rail Thickness: 1-3/4 inches.
8. Glass: Complying with Section 088000 "Glazing."
9. Door Construction for Transparent Finish::

    a. Non-fire-rated doors: Veneered, structural composite lumber. Select veneers for similarity of grain and color, and arrange for optimum match between adjacent pieces. Use veneers not less than 1/16 inch thick.
    b. Fire rated doors: Edged and veneered mineral-core stiles and rails. Where raised panels are used, provide veneered mineral-core raised panels.

2.4 STILE AND RAIL WOOD DOOR FABRICATION

A. Fabricate stile and rail wood doors in sizes indicated for field fitting.

B. Factory fit doors to suit frame-opening sizes indicated, with the following uniform clearances and bevels unless otherwise indicated:

1. Clearances: Provide 1/8 inch at heads, jambs, and between pairs of doors. Provide 1/2 inch from bottom of door to top of decorative floor finish or covering. Where threshold is shown or scheduled, provide not more than 3/8 inch from bottom of door to top of threshold.

    a. Comply with NFPA 80 for fire-rated doors.

2. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
3. Bevel fire-rated doors 1/8 inch in 2 inches on lock edge; trim stiles and rails only to extent permitted by labeling agency.

C. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.

1. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining.

D. Glazed Openings: Factory install glazing in doors, complying with Section 088000 "Glazing." Install glass using manufacturer's standard elastomeric glazing sealant complying with ASTM C 920. Secure glass in place with removable wood moldings. Miter wood moldings at corner joints.

2.5 FACTORY FINISHING

A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.

B. Finish faces, all four edges, edges of cutouts, and mortises. Fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.

C. Factory finish doors.

D. Transparent Finish:

1. Grade: Premium.
2. Finish: WDMA TR-6, catalyzed polyurethane.
3. Staining: Custom to match Architect's sample.
4. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames, with Installer present, before hanging doors.

1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install stile and rail wood doors level, plumb, square, true to line; without distortion, warp, or rack, and without impeding movement; anchored securely in place. Comply with Drawings and manufacturer’s written instructions.

1. Stile and rail wood doors shall be properly installed such that without closer attached, door opening force is 1 lbf or less.

B. Hardware: For installation, see Section 087100 "Door Hardware."

C. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

1. Install fire-rated doors according to NFPA 80.
2. Install smoke- and draft-control doors according to NFPA 105.

D. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted with fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.

1. Clearances: Provide 1/8 inch at heads, jambs, and between pairs of doors. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.

a. Comply with NFPA 80 for fire-rated doors.

2. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
3. Bevel fire-rated doors 1/8 inch in 2 inches on lock edge; trim stiles and rails only to extent permitted by labeling agency.

E. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

F. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081433

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes access doors and frames for walls and ceilings, fire-resistant rated where installed in fire-resistant rated construction.

B. Related Requirements:

1. Section 013000 “Project Management and Coordination” for coordination drawings indicating locations of access doors and frames.
2. Section 233300 "Air Duct Accessories" for heating and air-conditioning duct access doors.

1.3 COORDINATION

A. Coordinate locations of all wall and ceiling access panels with mechanical, plumbing, fire-protection and electrical trades. Provide access panels, whether indicated or not, to permit proper operation of equipment within walls or above inaccessible ceilings. Access panels shall be fire-resistant rated when constructed in a fire-resistant rated assembly. Final location of access panels shall be subject to Architect/Engineer review, per the submittals required below, and prior to installation.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, fire ratings, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings:

1. In addition to coordination drawings required per Section 013000 “Project Management and Coordination,” include plans, elevations, sections, details, and attachments to other work.
2. Detail fabrication and installation of access doors and frames for each type of substrate.

C. Samples: For each type of access door and frame and for each finish specified, complete assembly minimum 6 by 6 inches in size.

D. Product Schedule: For access doors and frames.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of access doors and frames that have been used for similar applications with successful results, that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports and labels.

B. Installer Qualifications: A firm with not less than 5 years' experience installing access doors and frames similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, according to NFPA 252 or UL 10B.

B. s and Other Air-Tight Rooms/Spaces:

1. Air Infiltration: Test according to ASTM E 283 for air infiltration as follows:

a. Maximum air leakage of 0.01 cfm/sq. ft at a static air pressure differential of 6.24 lbf/sq. ft.

2. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:

a. No leakage when tested at a static pressure differential of 15.05 lbf/sq. ft.

C. Size Variations: Obtain Architect's acceptance of manufacturer's standard-size units, which may vary slightly from sizes indicated.

2.2 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

A. Manufacturers: Subject to compliance with requirements, provide access doors and frames by one of the following:

1. Elmdor / Stoneman Manufacturing Company.
   a. Ceilings: Recessed steel, Model CFR. Infill recessed door with matching ceiling material and finish flush with the adjacent wall or ceiling surface.
   b. Walls:
      1) Acoustic-Rated Walls: Flush steel, Model ED.
      2) Toilet Room Walls: Flush stainless steel: Model DW in stainless steel finish.
      3) Other Walls: Flush steel, Model DW.
   c. Fire-Resistant Rated: Flush steel, Model FR.

2. Nystrom, Inc.
   a. Ceilings: Recessed steel, Model R. Infill recessed door with matching ceiling material and finish flush with the surrounding ceiling surface.
   b. Walls:
      1) Acoustic-Rated Walls: Flush steel, Model XT.
      2) Toilet Room Walls: Flush Stainless Steel: Model PT.
      3) Other Walls: Flush steel: Model N.
   c. Fire-Resistant Rated: Flush steel, Model U.

3. Milcor Inc.
   a. Ceilings: Recessed steel, Model DWR. Infill recessed door with matching ceiling material and finish flush with the surrounding ceiling surface.
   b. Walls:
      1) Acoustic-Rated Walls: Flush steel, Model UFR.
      2) Toilet Room Walls: Flush Stainless Steel: Model M in stainless steel finish.
      3) Other Walls: Flush steel: Model M.
   c. Fire-Resistant Rated: Flush steel, Model UFR.

4. Acudor Products, Inc.
   a. Walls and Ceilings of s and other rooms/spaces indicated to have an air-tight seal: Model ADWT with stainless steel finish.

5. Source Limitations: Obtain each type of access door and frame through one source from a single manufacturer.

B. Recessed Access Doors with Concealed Flanges:

1. Description: Door face recessed for gypsum board infill; with concealed flange for gypsum board installation and concealed hinge.
2. Locations: Ceiling.
3. Door Size: In accordance with "Coordination" Article above, minimum size required for equipment access.
4. Steel Sheet for Door: Nominal 16 gage; factory primed.
5. Latch and Lock (Ceilings): Cam latch, screwdriver operated, unless otherwise indicated.

C. Flush Access Doors with Exposed Flanges:

1. Description: Face of door flush with frame, with exposed flange and concealed hinge.
2. Locations: Walls.
3. Door Size: In accordance with "Coordination" Article above, minimum size required for equipment access.
4. Steel Sheet for Door: Nominal 16 gage galvanized and factory primed, except provide stainless steel No. 4 finish at toilet room walls.
5. Insulation and Gasketing: Minimum 1-inch-thick insulation and gasketing at access doors in acoustic-rated walls.
6. Frame Material: Same material, thickness, and finish as door.
7. Latch and Lock (Walls): Cam latch, key operated, unless otherwise indicated.

D. Fire-Resistant Rated Doors: Provide in fire-resistant rated walls and ceilings.

2.3 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.

D. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304. Remove tool and die marks and stretch lines, or blend into finish.

E. Frame Anchors: Same material as door face.

F. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

G. Drywall Beads: Edge trim formed from 0.0299-inch zinc-coated steel sheet formed to receive joint compound and in size to suit thickness of gypsum board.

2.4 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.

1. For concealed flanges with drywall bead, provide edge trim for gypsum panels securely attached to perimeter of frames.
2. For concealed flanges with plaster bead for full-bed plaster applications, provide zinc-coated expanded-metal lath and exposed casing bead welded to perimeter of frames.

D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling. Provide access sleeves for each latch operator and install in holes cut through finish.

E. Latching Mechanism: Furnish number required to hold doors in flush, smooth plane when closed.

1. For recessed panel doors, provide access sleeves for each locking device. Furnish plastic grommets and install in holes cut through finish

2.5 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Factory Finished: Apply manufacturer's standard baked-enamel or powder-coat finish immediately after cleaning and pretreating, with minimum dry-film thickness of 1 mil for topcoat.

a. Color: Match Architect's sample.

E. Stainless-Steel Finishes:

1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
2. Polished Finish: No. 4 finish. Grind and polish surfaces to produce uniform finish, free of cross scratches.

a. Run grain of directional finishes with long dimension of each piece.
b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.3 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 083113

SECTION 083323 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes motorized insulated service doors.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for miscellaneous steel supports.
2. Division 26 Section(s) for wiring of connections and accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type and size of overhead coiling door and accessory.

1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
3. Include description of automatic closing device and testing and resetting instructions.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
4. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
5. Show locations of controls, locking devices, and other accessories.
6. Include diagrams for power, signal, and control wiring.

C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.

1. Include similar Samples of accessories involving color selection.

D. Samples for Verification: For each type of exposed finish on the following components, in manufacturer's standard sizes:

1. Curtain slats.
2. Bottom bar with sensor edge.
3. Guides.
4. Brackets.
5. Hood.
6. Locking device(s).
7. Include similar Samples of accessories involving color selection.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of overhead coiling doors that have been used for similar applications with successful results, that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports and labels. Manufacturer shall have factory-authorized service representatives who are available for consultation, periodic Project-site observations, and on-site assistance.

B. Installer Qualifications: A firm with not less than 10 years' experience installing overhead coiling doors similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

1. Overhead Door Corporation:

a. Exterior Locations: "Stormtite AP Model 627," motorized, with options as needed to comply with specified requirements.

2. Or Comparable Product by one of the following:

a. McKeon Door Company.
b. Wayne-Dalton Corp.

B. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.

1. Obtain operators and controls from overhead coiling door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General: Overhead coiling doors shall be in compliance with the 2016 California Building Code.

B. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.

1. Design Wind Load: Based on criteria indicated on the Structural Drawings.
2. Testing: According to ASTM E 330.
3. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.

C. Seismic Performance: Overhead coiling doors shall withstand the effects of earthquake motions determined according to the 2016 California Building Code.

1. Component Importance Factor: 1.0.

D. Operation Cycles: Door components and operators capable of operating for not less than 20,000 cycles. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

E. Air Infiltration: Maximum rate of 1.0 CFM per square foot at 1.57 psf when tested according to ASTM E 283, and in compliance with Section 110.6 (a) 1 of the 2016 California Energy Code.

F. Curtain R-Value for Exterior Doors: Insulated slats complying with the following:

1. Maximum U 1.45 in compliance with Table 140.3-B of the 2016 California Energy Code.

G. Slats and insulation shall have a maximum flame spread index of 75 and a maximum smoke developed index of 450 when tested according to ASTM E 84.

2.3 DOOR ASSEMBLY

A. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.

B. Door Curtain Material: Galvanized steel, in thickness required to meet performance requirements, but no less than the following:

1. Minimum 22 gauge front panel and 24 gauge back panel.

C. Door Curtain Slats: Flat profile slats, in manufacturer's standard size and thickness complying with performance requirements.

1. Insulated-Slat Interior Facing: Metal.
2. Gasket Seal. Manufacturer's standard continuous gaskets between slats.

D. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch thick; fabricated from hot-dip galvanized steel and finished to match door.

E. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.

F. Hood (where exposed to view): Match curtain material and finish.

1. Shape: As shown on Drawings, or if not indicated, square.
2. Mounting: As shown on Drawings, or if not indicated, face of wall.

G. Locking Device Assembly: Equip door with locking device assembly.

1. Locking Device Assembly: Single-jamb side locking bars, operable from inside and outside, with cylinders.

H. Electric Door Operator:

1. Operation Classification (Door and Operator System): Heavy duty, minimum 20,000 cycles.
2. Operator Location: As indicated on Drawings, or if not indicated, provide either top-of-hood or front-of-hood, depending on ceiling height restrictions.
3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use.
4. Motor Exposure: Interior.
5. Emergency Manual Operation: Chain type.
6. Control Station(s): Interior mounted, in location indicated on Drawings, or if not indicated, as directed by Architect.
7. Obstruction-Detection Device: Automatic, manufacturer’s standard.

a. Sensor Edge Bulb Color: As selected by Architect from manufacturer's full range.

I. Curtain Accessories: Equip door with weatherseals and automatic closing device.

J. Door Finish:

1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.
2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2.4 MATERIALS, GENERAL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.5 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural steel sheet; complying with ASTM A 653, with G90 zinc coating.
2. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84 or UL 723. Enclose insulation completely within slat faces.
3. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face, minimum 24 gauge.
4. Gasket Seal: Provide insulated slats with manufacturer's standard continuous gaskets between slats.

B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks.

2.6 HOODS

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

1. Galvanized Steel: Nominal 22 gauge, hot-dip galvanized steel sheet with G90 zinc coating, complying with ASTM A 653.

B. Removable Metal Soffit: Formed or extruded from same metal and with same finish as curtain if hood is mounted above ceiling unless otherwise indicated.

2.7 LOCKING DEVICES

A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.

B. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.

1. Lock Cylinders: As specified in Section 087100 "Door Hardware".

C. Chain Lock Keeper: Suitable for padlock.

D. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.8 CURTAIN ACCESSORIES

A. Weatherseals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.

1. At door head, use 1/8-inch-thick, replaceable, continuous-sheet baffle secured to inside of hood or field- installed on the header.
2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch-thick seals of flexible vinyl, rubber, or neoprene.

2.9 COUNTERBALANCING MECHANISM

A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless or welded carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load.

C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.

D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.10 ELECTRIC DOOR OPERATORS

A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

1. Comply with NFPA 70.
2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.

B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.

C. Door Operator Location(s): As indicated on Drawings, or if not indicated, provide either top-of-hood or front-of-hood mounting, subject to ceiling height limitations.

1. Top-of-Hood Mounted: Operator is mounted to the right or left door head plate with the operator on top of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Headroom is required for this type of mounting.
2. Front-of-Hood Mounted (unless otherwise indicated): Operator is mounted to the right or left door head plate with the operator on coil side of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Front clearance is required for this type of mounting.

D. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated.

1. Electrical Characteristics:

a. Phase and Voltage: As indicated on electrical Drawings, or if not indicated, of a phase/voltage that operates on house power without the need of a supplemental transformer.
b. Hertz: 60.

2. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
3. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.

E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

F. Obstruction Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. For non-fire-rated doors, activation of device immediately stops and reverses downward door travel. Provide one of the following:

1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.

a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, door closes only with sustained or constant pressure on close button.

2. Electric Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.

a. Self-Monitoring Type: Four-wire configured device designed to interface with door operator control circuit to detect damage to or disconnection of sensor edge.

G. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."

1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.

H. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation.

I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

K. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with regulatory requirements for accessibility.

2.11 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.12 STEEL AND GALVANIZED-STEEL FINISHES

A. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Examine locations of electrical connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.

C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

D. Power-Operated Doors: Install according to UL 325.

3.3 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
3. Test door closing when activated by detector or alarm-connected automatic-closing system. Reset door-closing mechanism after successful test.

3.4 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

1. Adjust exterior doors and components to be weather-resistant.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

C. Adjust seals to provide tight fit around entire perimeter.

3.5 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of coiling-grille Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for grille operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Perform maintenance, including emergency callback service, during normal working hours.
2. Include 24-hour-per-day, 7-day-per-week, emergency callback service.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION 083323

SECTION 083483 - ELEVATOR DOOR SMOKE CONTAINMENT SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Smoke detector-activated hoistway door smoke containment screen and control system designed to provide a tight-fitting, smoke- and draft-control assembly.

B. Related Requirements:

1. Section 083113 "Access Doors and Frames."
2. Section 092216 "Non-Structural Metal Framing" for metal backing in housing mounting area.
3. Section 099123 "Interior Painting" for field painting of specified components.
4. Division 14 Section(s) for elevators.
5. Division 26 Section(s) for 120v and control circuit power, including conduit, boxes, conductors, wiring devices, and emergency power.
6. Division 28 Section(s) for detection and alarm systems.

1.3 REFERENCES

A. ASTM A240: Standard Specification for Heat Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels.

B. ICC Evaluation Service ES-AC77: Acceptance Criteria for Smoke-Containment Systems Used With Fire-Resistive Elevator Hoistway Doors and Frames.

C. ICC Evaluation Service report ESR-1136.

D. NFPA Codes and Standards:

1. 70 – National Electrical Code.
2. 72 – National Fire Alarm Code -2007, 2010 and 2013.

E. ASTM E 84: Test Method for Surface Burning Characteristics of Building Materials.

F. UL Standards:

1. 268 – Smoke Detectors for Fire Protective Signaling Systems.
2. 864 – Control Units for Fire Protective Signaling Systems.
3. 1784 – Air Leakage Tests for Door Assemblies.

1.4 COORDINATION

A. Coordinate elevator door smoke containment system with installation of adjacent construction, including, but not limited to, elevator, wall and ceiling/soffit height. Review during preconstruction meeting.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data: Include operation, safety features, finishes, and similar information.

B. Shop Drawings: For elevator smoke containment system.

1. Show plans, elevations, sections, and large-scale details indicating operation at each landing, coordination with building structure and with ceiling/soffit, and relationships with other construction and locations of equipment and signals.

C. Samples for Initial Selection: For finishes involving color selection.

D. Samples for Verification: For exposed finishes.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

C. Research / Evaluation Report: From ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

D. Sample warranty.

1.8 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For smoke containment door to include in emergency, operation, and maintenance manuals.

1.9 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of elevator door smoke containment system that has been used for similar applications with successful results, that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports and labels. Manufacturer shall have a current research / evaluation report from ICC-ES or equivalent.

B. Installer Qualifications: A firm with not less than 5 years' experience installing elevator door smoke containment system similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

1.10 DELIVERY, STORAGE AND HANDLING

A. Comply with manufacturer's written instructions.

1.11 WARRANTY

A. Special Manufacturer's Warranty: Manufacturer's standard or customized form in which manufacturer agrees to repair or replace components of elevator door smoke containment system that fail in material or workmanship within the specified warranty period.

1. Warranty Period: Four (4) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with the performance requirements, provide the following:

1. Smoke Guard. 287 N. Maple Grove, Boise, Idaho 83704; 800-574-0330; www.smokeguard.com

a. Model: 600.
b. Painting: Paint auxiliary rails in accordance with manufacturer's written instructions.

2. Or a Comparable Product by one of the following:

a. Door Systems Inc.; DSI 600.

B. Source Limitations: Obtain elevator doors smoke containment system from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Elevator door smoke containment system shall be in compliance with the 2015 International Building Code (IBC) and 2016 California Building Code (CBC).

B. Air Leakage: Not to exceed 3 cfm per sf of door opening at 0.1 in water pressure differential at ambient temperature and 400 degrees F (204 degrees C) tested per IBC.

2.3 MATERIALS

A. Screen.

1. Film: Minimum 1-mil thick transparent polyimide film reinforced with 100-denier nomex yarn at 0.25-in each way.
2. Magnetic Strips: Flexible multi-pole strips attached to longitudinal edges of film with low modulus silicone adhesive.

B. Housing: 20-gage, powder coated, cold rolled or stainless steel container and door with concealed hinges, and latch.

C. Auxiliary Rails:

1. Material: 16 gage ASTM A 240, Type 430, ferritic stainless steel.
2. Size: 2 in wide by depth as required to project beyond face of elevator door frame.

D. Cove Bases (required for hoistway openings wider than 60 inches): 16 gage ASTM A 240/240M, Type 430, ferritic stainless steel.

E. Rewind Motor: Top or side mount, as required to meet ceiling/soffit clearances , NFPA 70.

F. Release Mechanism: IAS (IAS is a trademark of International Accreditation Service) Accredited Testing Laboratory Labels for UL Standard 864.

G. Control Station: Metal box with battery backup, power disconnect with integral circuit breaker, step down power transformer (120v AC to 12v DC), and controller circuit board.

1. Emergency Power Supply: 12v DC battery with charger.

H. Wall Switch: Include switch to rewind screen into housing, system status indicators, keyed screen deployment switch, and keyed-to-silence function.

I. Screen Rewind Switch: Include switch to rewind screen into housing.

2.4 IDENTIFICATION

A. Label each smoke containment system with following information:

1. Manufacturer’s name.
2. Maximum leakage rating at specified pressure and temperature conditions.
3. Label of quality control agency.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.

1. Verify related work performed under other sections is complete and in accordance with Shop Drawings.
2. Verify wall surfaces and elevator door frames are acceptable for installation of smoke containment system components.
3. Verify existing field painted elevator door frames to be used for screen adherence have been repainted in accordance with smoke containment system manufacturer’s instructions or they have the original factory paint.
4. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Commencement of work by installer is acceptance of conditions.

3.2 INSTALLATION

A. Install elevator door smoke containment system in accordance with manufacturer's written installation instructions.

3.3 FIELD QUALITY CONTROL

A. Field Test: Follow manufacturer's cycle test procedures:

1. Notify Owner's Representative, local Fire Marshal, alarm sub-contractor, and elevator sub-contractor minimum one week in advance of scheduled testing.
2. Complete maintenance service record.

3.4 DEMONSTRATION AND CLEANING

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate, adjust, and maintain elevator door smoke containment system.

B. Clean in accordance with manufacturer's written instructions.

3.5 MAINTENANCE SERVICE

A. Maintenance and Testing:

1. Perform minimum and semi-annual maintenance and testing one each smoke containment system as required by the manufacturer's warranty, code agency evaluation reports, and as required by Authorities Having Jurisdiction.
2. Battery Backup: Test semi-annually and replace every three years minimum.
3. Retain permanent record of tests.

END OF SECTION 083483

SECTION 083800 - TRAFFIC DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes medium-impact traffic doors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of traffic door.

1. Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions.

B. Shop Drawings: For traffic doors.

1. Include plans, elevations, sections, and details.
2. Detail attachments to other work, and between units, if any.
3. Include hardware and required clearances.

C. Samples: For doors with factory-applied color finishes.

1. Include Samples of hardware and accessories involving color selection.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranty: For special warranty.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An installer acceptable to traffic door manufacturer for installation of units required for this Project.

1.6 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace traffic doors that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

a. Traffic Door: Four years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide traffic doors by the following:

1. Eliason Corporation; "EHH-3 Stainless Steel Traffic Door"

B. Source Limitations: Obtain traffic doors from single source from single manufacturer.

2.2 TRAFFIC DOORS

A. Medium Impact Traffic Doors: 3/4 inch exterior grade solid wood core; 1 inch total thickness.

1. Facing: Reinforced metal plates.

a. Top Panels: Decorative laminate both sides.
b. Base Plates: 48 inches high, 18 gauge stainless steel, both sides; stainless steel edge trim and top hinge covers.

2. Window Size: 9 inches wide by 14 inches high.
3. Window Molding: Black rubber molding.
4. Glazing: Manufacturer’s standard acrylic or polycarbonate safety glazing.

a. Safety Glazing Labeling: Permanently mark safety glazing with certification label of the SGCC. Label shall indicate manufacturer's name, type of glazing, thickness, and safety glazing standard with which glazing complies.

5. Finish: Stainless steel, 20 gauge.

2.3 HARDWARE

A. General: Provide manufacturer's standard hardware, fabricated from a corrosion-resistant material designed to smoothly operate and sized to accommodate panel weight and dimensions.

B. Hinges: Double action easy swing hinges.

1. Finish: Stainless steel.

2.4 FABRICATION

A. Fabricate traffic doors in sizes indicated. Include a complete system for assembling components and anchoring doors.

B. Factory machine traffic doors for openings and hardware that is not surface applied.

C. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation. Allow for scribing, trimming, and fitting at Project site.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of Work.

B. Verify rough opening dimensions, levelness of threshold substrate, and operational clearances.

C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated, hinged traffic door installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing hinged doors, hardware, accessories, and other components.

B. Install traffic doors level, plumb, square, true to line; without distortion, warp, or rack of frames and panels, and without impeding thermal movement; anchored securely in place to structural support; and in proper relation to adjacent construction.

3.3 ADJUSTING, CLEANING, AND PROTECTION

A. Lubricate hardware and moving parts.

B. Adjust operating panels and screens to provide smooth operation without binding.

C. Adjust hardware for proper alignment, smooth operation without unnecessary force or excessive clearance.

D. Clean exposed surfaces immediately after installing traffic doors. Avoid damaging protective coatings and finishes. Remove nonpermanent labels, excess sealants, glazing materials, dirt, and other substances.

E. Remove and replace glazing that has been broken, chipped, cracked, abraded, or damaged during construction period.

F. Protect traffic door surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances contact traffic door surfaces, remove contaminants immediately according to manufacturer's written instructions.

G. Refinish or replace traffic doors with damaged finishes.

H. Replace damaged components.

END OF SECTION 083800

SECTION 084113 - INTERIOR ALUMINUM-FRAMED STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Interior storefront framing.
2. Interior manual-swing entrance doors and door-frame units.

B. Engineering Responsibility: If manufacturer's system is not pre-engineered to meet performance requirements, contractor's responsibility includes providing professional engineering services needed to assume engineering responsibility for interior aluminum-framed storefronts.

C. Related Requirements:

1. Section 055000 "Metal Fabrications" for steel not provided as part of this Section.
2. Section 079200 "Joint Sealants" for installation of joint sealants installed with aluminum-framed storefronts and for sealants to the extent not specified in this Section.
3. Section 087100 "Door Hardware" for door hardware to be installed in aluminum-framed entrances.
4. Section 088000 "Glazing" for glazing within aluminum-framed entrances and storefronts.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. General: Transmit all action and informational submittal items together in one single complete submittal package for review.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

C. Sustainable Design Submittals: Product data for sealants, indicating VOC content.

D. Shop Drawings: For aluminum-framed entrances and storefronts. Provide project-specific shop drawings including plans, elevations, sections, full-size details, and attachments to other work.

1. Include full-size isometric details of each vertical-to-horizontal intersection of aluminum-framed entrances and storefronts, showing the following:

a. Joinery, including concealed welds.
b. Anchorage.
c. Expansion provisions.
d. Glazing.

2. If manufacturer's interior aluminum-framed storefront system is not pre-engineered to meet performance requirements, provide shop drawings and analysis data stamped and signed by the qualified California-licensed professional engineer responsible for their preparation.

E. Samples for Initial Selection: For units with factory-applied color finishes.

F. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

G. Samples for Glazing: For each type of glass, 12 inch square.

H. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer, installer, and professional engineer.

B. Product Test Reports: For aluminum-framed entrances and storefronts, for tests performed by manufacturer and witnessed by a qualified testing agency.

C. Welding certificates.

D. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For aluminum-framed entrances and storefronts to include in maintenance manuals.

B. Maintenance Data for Structural Sealant: For structural-sealant-glazed storefronts to include in maintenance manuals. Include ASTM C 1401 recommendations for post-installation-phase quality-control program.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of aluminum-framed storefronts that have been used for similar applications with successful results, that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports, labels, and calculations. Manufacturer shall have factory-authorized service representatives who are available for consultation, periodic Project-site observations, and on-site assistance.

B. Installer Qualifications: A firm with not less than 10 years' experience installing interior aluminum-framed storefronts similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

C. Engineering Responsibility: If manufacturer's system is not pre-engineered to meet performance requirements, Contractor's responsibility includes providing professional engineering services needed to assume engineering responsibility for interior aluminum-framed storefronts.

1. Prepare data for interior aluminum-framed storefronts, including Shop Drawings, based on testing and engineering analysis for manufacturer's standard units in systems similar to those indicated for the Project and submission of reports of tests performed on manufacturer's standard assemblies, signed and sealed by the qualified California-licensed professional engineer responsible for their preparation.

D. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

E. Welding Standards: Comply with applicable provisions of AWS D1.2, "Structural Welding Code – Aluminum".

1.8 COORDINATION

A. Coordinate installation of miscellaneous metal sub-framing, anchorage items, or other items to be embedded in or attached to other construction before starting that Work. Provide locations, setting diagrams, templates, instructions, and directions for installation. Deliver such items to Project site in time for installation.

B. Pre-Installation Field Measurements: Coordinate exact hardware and anchorage locations with other Trade Contractors before permanently attaching to other construction.

C. Post-Installed Field Measurements: Field verify and examine actual installed locations of connection hardware and anchorage items prior to installation of Work provided under this Section. Notify General Contractor and Architect immediately of any discrepancies in writing. Provide letter from curtain wall installer indicating acceptance of connection hardware and anchorage items.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.
b. Noise or vibration created by thermal or structural movements.
c. Deterioration of metals, metal finishes, and other materials beyond normal use.
d. Sealant failure.
e. Failure of operating components.

2. Warranty Period: 10 years from date of Substantial Completion.

B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide aluminum-framed entrances and storefronts by the following:

1. Kawneer Company, Inc.:

a. SF-1: "Trifab VG 450," retained mechanically with gaskets (mullions) on four sides.
b. SF-2: "Trifab VG 450," retained mechanically with gaskets (mullions) on two sides and structural silicone glazed (SSG) on the other two sides.

2. Or Comparable Equal, by one of the following:

a. Arcadia Inc.

B. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing and accessories, from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:

a. Thermal stresses transferring to building structure.
b. Glass breakage.
c. Noise or vibration created by thermal or structural movements.
d. Loosening or weakening of fasteners, attachments, and other components.
e. Sealant failure.
f. Failure of operating units.

3. Aluminum-framed storefronts and entrances shall accommodate tolerance in construction, including, but not limited to, those from structural frame tolerances, manufacturing tolerances, and field installation tolerances.
4. Aluminum-framed storefronts and entrances shall comply with the 2016 California Building Code.

B. Interstory Drift: Accommodate design displacement of adjacent stories indicated.

1. Design Displacement: As indicated on Drawings.

C. Seismic Performance: Aluminum-framed entrances and storefronts shall withstand the effects of earthquake motions determined according to the 2016 California Building Code.

1. Seismic Drift Causing Glass Fallout: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.6 at design displacement.

D. Glazing: Physically isolate glazing from framing members.

E. Structural-Sealant Joints: Designed to produce tensile or shear stress of less than 20 psi.

F. Structural Sealant: Capable of withstanding tensile and shear stresses imposed by structural-sealant-glazed curtain walls without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant shall occur before adhesive failure.

1. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.
2. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate because sealant-to-substrate bond strength exceeds sealant's internal strength.

G. Dimensional Tolerances: Provide entrance and storefront systems that accommodate dimensional tolerances of building frame and other adjacent construction.

H. Accessibility Requirements: Comply with applicable provisions in the 2010 ADA Standards for Accessible Design and the accessibility requirements of the 2016 CBC for door hardware on doors in an accessible route.

1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
2. Comply with the following maximum opening-force requirements:

a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.

3. Provide thresholds not more than 1/2 inch high. Changes in level between 1/4 inch high minimum and 1/2 inch high maximum shall be beveled with a slope not steeper than 1:2.
4. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch.
5. Door closers and stops shall not reduce headroom to less than 78 inches.
6. Floor-mounted door stops and other similar obstructions shall be installed 4 inches maximum from the face of the wall or partition. Floor stops shall not be located in the path of travel.
7. Panic hardware shall be mounted between 36 inches and 44 inches above finished floor such that the clear width of the exitway is not less than 32 inches measured between the face of the door and the opposite stop. The unlatching force of panic hardware shall not exceed 5 lbs, applied in the direction of travel.
8. Swinging door surfaces within 10 inches of the finish floor or ground surface measured vertically shall have a smooth surface on the push side extending the full width of the door.

2.3 FRAMING

A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Nonthermal.
2. Glazing System:

a. SF-1: Retained mechanically with gaskets on four sides.
b. SF-2: Retained mechanically with gaskets on two sides and structural silicone glazed on the other two sides.

3. Glazing Plane:

a. SF-1: As indicated on Drawings.
b. SF-2: Flush glazed.

4. Finish: High-performance organic finish.
5. Fabrication Method: Field-fabricated stick system.

B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

D. Materials:

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

a. Sheet and Plate: ASTM B 209.
b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
c. Extruded Structural Pipe and Tubes: ASTM B 429.
d. Structural Profiles: ASTM B 308.

2. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.

a. Structural Shapes, Plates, and Bars: ASTM A 36.
b. Cold-Rolled Sheet and Strip: ASTM A 1008.
c. Hot-Rolled Sheet and Strip: ASTM A 1011.

2.4 ENTRANCE DOOR SYSTEMS

A. Entrance Doors: Manufacturer's heavy-duty glazed entrance doors for manual-swing operation.

1. Door Construction: 1-3/4-inch overall thickness, with minimum 0.188-inch-thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
2. Door Design: As indicated, or if not indicated, manufacture's medium stile; 3-1/2-inch nominal head and side rails, with a minimum 10-inch bottom rail.
3. Glazing Stops and Gaskets: Square Insert description, snap-on, extruded-aluminum stops and preformed gaskets.

    a. Provide nonremovable glazing stops on outside of door.

4. Finish: High-performance organic finish.

2.5 ENTRANCE DOOR HARDWARE

A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."

2.6 GLAZING

A. Glazing: Comply with Section 088000 "Glazing."

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers, fabricated from an elastomer of type and in hardness recommended by system and gasket manufacturer to comply with system performance requirements.

C. Glazing Sealants: As recommended by manufacturer.

D. Sealants used inside the building envelope shall have a maximum VOC content of 250 g/L.

E. Structural Glazing Sealants: ASTM C 1184, chemically curing silicone formulation that is compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant and approved by structural-sealant manufacturer for use in storefront assembly indicated.

1. Color: Black.

F. Sealants: ASTM C 920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant and structural-sealant-glazed storefront manufacturers for this use.

1. Color: As indicated on Drawings, or if not indicated, as selected by Architect from manufacturer's full range of sealant colors.

2.7 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.

B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123 or ASTM A 153 requirements.

C. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

2.8 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. Storefront Framing: Provide subframes and reinforcing of types indicated or, as required for a complete system. Factory assemble components to greatest extent possible. Disassemble components only as necessary for shipment and installation.

F. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

1. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.

G. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

H. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

I. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.9 ALUMINUM FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in 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.

C. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: Custom color to match Architect's sample.

2.10 SOURCE QUALITY CONTROL

A. Structural Sealant: Perform quality-control procedures complying with ASTM C 1401 recommendations including, but not limited to, assembly material qualification procedures, sealant testing, and assembly fabrication reviews and checks.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare surfaces that are in contact with sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

3.3 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Seal perimeter and other joints unless otherwise indicated.

B. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 "Joint Sealants."

D. Install components plumb and true in alignment with established lines and grades.

E. Install operable units level and plumb, securely anchored, and without distortion. Adjust seals and hardware movement to produce proper operation.

F. Install glazing as specified in Section 088000 "Glazing."

G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

1. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.
2. Aluminum framed entrance doors shall be properly installed such that without closer attached, opening force is 1 lbf or less.

3.4 ERECTION TOLERANCES

A. Erection Tolerances: Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
3. Alignment:

    a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
    b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
    c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.

4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.5 FIELD QUALITY CONTROL (BY OWNER)

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Field and shop welds in compliance with CBC 1705.2.
2. Post-installed concrete anchors in compliance with CBC 1705.3.

B. Aluminum-framed storefronts will be considered defective if they do not pass tests and inspections.

C. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

E. Prepare test and inspection reports.

3.6 MAINTENANCE SERVICE

A. Entrance Door Hardware:

1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.
2. Initial Maintenance Service: Beginning at Substantial Completion, provide six months' full maintenance by skilled employees of entrance door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Use parts and supplies that are the same as those used in the manufacture and installation of original equipment.

3.7 ADJUSTING

A. Adjust entrance doors and hardware to produce smooth operation and tight fit at contact points.

1. For aluminum-framed entrance doors accessible to people with disabilities:

    a. Adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches from the latch measured to the leading door edge.
    b. Adjust door hardware to comply with the accessibility portion of the “Performance Requirements” Article in Part 2.

3.8 CLEANING AND PROTECTION

A. Provide final protection and maintain conditions in a manner acceptable to manufacturer and Installer that ensure entrance and storefront systems are without damage or deterioration at the time of Substantial Completion.

B. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

C. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 084113

SECTION 084126 - ALL-GLASS ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Interior and exterior swinging all-glass entrances.
2. All-glass sidelights.
3. Interior all-glass storefronts.

B. Engineering Responsibility: If manufacturer's system is not pre-engineered to meet performance requirements, contractor's responsibility includes providing professional engineering services needed to assume engineering responsibility for all-glass entrances and storefronts.

C. Related Requirements:

1. Section 035416 "Hydraulic Cement Underlayment" for leveling concrete slab substrates below all-glass entrances and sidelights.
2. Section 055000 "Metal Fabrications" for overhead-steel support for all-glass systems.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for all-glass system.

B. Shop Drawings: For all-glass entrances.

1. Include plans, elevations, and sections.
2. Include details of fittings and glazing, including isometric drawings of fittings and extrusions.
3. Door hardware locations, mounting heights, and installation requirements.
4. If manufacturer's all-glass entrances and storefronts are not pre-engineered to meet performance requirements, Contractor's responsibility includes providing professional engineering services needed to assume engineering responsibility for all-glass entrances and storefronts.

a. Shop Drawings shall be signed and sealed by a California-licensed professional engineer responsible for their preparation, indicating compliance with performance requirements.

C. Samples:

1. For each type of exposed finish indicated.
2. Glazing Samples: For each type of glazing type, 12 inches square.
3. Door Hardware: For exposed door hardware of each type, in specified finish, full size.

D. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors sidelights, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Product Test Reports: For all-glass systems, for tests performed by a qualified testing agency.

C. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For all-glass systems to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of all-glass entrances and storefronts that have been used for similar applications with successful results, that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports and labels.

B. Installer Qualifications: A firm with not less than 5 years' experience installing all-glass entrances and storefronts similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

C. Engineering Responsibility: If manufacturer's all-glass entrances and storefronts are not pre-engineered to meet performance requirements, Contractor's responsibility includes providing professional engineering services needed to assume engineering responsibility for all-glass entrances and storefronts.

1. Prepare data for all-glass entrances and storefronts, including Shop Drawings, based on testing and engineering analysis for manufacturer's standard units in systems similar to those indicated for the Project and submission of reports of tests performed on manufacturer's standard assemblies, signed and sealed by the qualified California-licensed professional engineer responsible for their preparation.

D. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard or customized form in which manufacturer and installer agree to repair or replace components of all-glass entrance and storefront systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
b. Failure of operating components.

2. Warranty Period: Four years from date of Substantial Completion, except as follows:

a. Concealed Floor Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide all-glass entrances and storefronts by the following:

1. Blumcraft of Pittsburgh; C.R. Laurence Co., Inc.; Series 1301.

B. Source Limitations: Obtain all-glass entrance and storefronts from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Comply with performance requirements specified, as determined by testing of all-glass entrances representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. All-glass entrances and storefronts shall comply with the 2016 California Building Code.

B. Engineering Responsibility: If manufacturer's all-glass entrances and storefronts are not pre-engineered to meet performance requirements, Contractor's responsibility includes providing professional engineering services needed to assume engineering responsibility for all-glass entrances and storefronts to meet specified performance requirements.

C. Structural Loads:

1. Exterior Wind Loads: As indicated on Drawings.
2. Interior Lateral Load: 5 lbf per square foot.
3. Other Design Loads: As indicated on Drawings.
4. Deflection Limits: Deflection normal to glazing plane is limited to 1/175 of clear span or 3/4 inch, whichever is smaller.

D. Seismic Performance: All-glass entrances shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

E. Story Drift: Accommodate displacement of adjacent stories indicated.

F. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

G. Safety Glazing: Provide safety glazing for locations subject to human impact as required per the 2016 California Building Code.

H. Accessibility Requirements: Comply with applicable provisions in the 2010 ADA Standards for Accessible Design and the accessibility requirements of the 2016 California Building Code for door hardware on doors in an accessible route.

1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
2. Comply with the following maximum opening-force requirements:

a. Interior and Exterior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.

3. Provide thresholds not more than 1/2 inch high. Changes in level between 1/4 inch high minimum and 1/2 inch high maximum shall be beveled with a slope not steeper than 1:2.
4. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch.

5. Door closers and stops shall not reduce headroom to less than 78 inches.
6. Floor-mounted door stops and other similar obstructions shall be installed 4 inches maximum from the face of the wall or partition. Floor stops shall not be located in the path of travel.
7. Panic hardware shall be mounted between 36 inches and 44 inches above finished floor such that the clear width of the exitway is not less than 32 inches measured between the face of the door and the opposite stop. The unlatching force of panic hardware shall not exceed 5 lbs, applied in the direction of travel.
8. Swinging door surfaces within 10 inches of the finish floor or ground surface measured vertically shall have a smooth surface on the push side extending the full width of the door.

2.3 METAL COMPONENTS

A. Fitting Configuration:

1. Manual-Swinging, All-Glass Entrance Doors and Sidelights: Continuous rail fitting at top and bottom.
2. All-Glass Storefronts: Continuous rail fitting at top and bottom.

B. Aluminum Extrusions: ASTM B 221, with strength and durability characteristics of not less than Alloy 6063-T5.

1. Stainless Steel Cladding: ASTM A 666, Type 304.

C. Anchors and Fastenings: Concealed.

D. Weather Stripping: Pile type; replaceable without removing all-glass entrance doors from pivots.

2.4 GLASS

A. Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated surfaces), Type I (transparent), tested for surface and edge compression per ASTM C 1048 and for impact strength per 16 CFR 1201 for Category II materials.

1. Class 1: Clear monolithic.

a. Thickness: Per manufacturer's published recommendations for height of door and storefront system, but no less than 1/2 inch.

2. Exposed Edges: Machine ground and flat polished.
3. Butt Edges: Flat ground.

2.5 ENTRANCE DOOR HARDWARE

A. General: Heavy-duty entrance door hardware units in sizes, quantities, and types recommended by manufacturer for all-glass entrance systems indicated. For exposed parts, match metal and finish of rail fittings.

B. Concealed Floor Closers and Top Pivots: Center hung; BHMA A156.4, Grade 1; including cases, bottom arms, top walking beam pivots, plates, and accessories required for complete installation.

1. Swing: Double acting.

a. Positive Dead Stop: Coordinated with hold-open angle if any, or at angle selected.

2. Hold Open: Automatic, at angle selected.

C. Concealed Overhead Holder: BHMA A156.8, Grade 1, with dead-stop setting coordinated with concealed floor closer.

D. Push-Pull Set: As selected from manufacturer's full range, stainless steel finish.

E. Cylinders: As specified in Section 087100 "Door Hardware."

F. Exit Devices: UL 305.

1. Basis-of-Design: Blumcraft "Panic Device H-100-D" with key cylinder.
2. Function: Operation by push-pull when inside operator is locked down (dogged).
3. Latching: At head.
4. Style: Exposed vertical/horizontal stainless steel rod.
5. Provide exit devices on both leaves of pairs of doors.

G. Threshold: ADA-compliant, not more than 1/2 inch high.

2.6 BUTT-GLAZING SEALANTS

A. Single-Component, Nonsag, Acid-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Uses NT, G, and A.

2.7 FABRICATION

A. Provide holes and cutouts in glass to receive hardware, fittings, and accessory fittings before tempering glass. Do not cut, drill, or make other alterations to glass after tempering.

1. Fully temper glass using horizontal (roller-hearth) process, and fabricate so that when glass is installed, roll-wave distortion is parallel with bottom edge of door or lite.

B. Factory assemble components and factory install hardware and fittings to greatest extent possible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install all-glass systems and associated components according to manufacturer's written instructions.

1. All-glass entrance system shall be properly installed such that without closer attached, door operating force is 1 lbf or less.

B. Set units level, plumb, and true to line, with uniform joints.

C. Maintain uniform clearances between adjacent components.

D. Lubricate hardware and other moving parts according to manufacturer's written instructions.

E. Set, seal, and grout floor closer cases as required to suit hardware and substrate indicated.

F. Install butt-joint sealants according to manufacturer's instructions and as specified in Section 079200 "Joint Sealants" to produce weathertight installation.

3.3 ADJUSTING AND CLEANING

A. Adjust all-glass entrance doors and hardware to produce smooth operation and tight fit at contact points and weather stripping.

1. For all-glass entrance doors accessible to people with disabilities, adjust closers to provide a three-second closer sweep period for doors to move from a 70-degree open position to 3 inches from the latch measured to the leading door edge.

B. Remove excess sealant and glazing compounds and dirt from surfaces.

END OF SECTION 084126

SECTION 084229 - INTERIOR SLIDING AUTOMATIC ENTRANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes interior all-glass power-operated sliding automatic entrances.

B. Engineering Responsibility: If manufacturer's system is not pre-engineered to meet performance requirements, contractor's responsibility includes providing professional engineering services needed to assume engineering responsibility for sliding automatic entrances.

C. Related Requirements:

1. Section 055000 "Metal Fabrications" for steel not provided as part of this Section.
2. Section 079200 "Joint Sealants" for installation of joint sealants installed with sliding automatic entrances.
3. Section 087100 "Door Hardware" for door hardware to be installed in sliding automatic entrances.
4. Divisions 26, 27, and/or 28 for electronic connections of sliding automatic entrance systems to electrical, security/access controls, and/or fire alarm system.

1.3 DEFINITIONS

A. AAADM: American Association of Automatic Door Manufacturers.

B. Activation Device: A control that, when actuated, sends an electrical signal to the door operator to open the door.

C. CBC: 2016 California Building Code.

D. Safety Device: A control that, to avoid injury, prevents a door from opening or closing.

E. For automatic door terminology, refer to BHMA A156.10 for definitions of terms.

1.4 COORDINATION

A. Templates: Distribute for doors, frames, and other work specified to be factory prepared for installing automatic entrances.

B. Coordinate hardware with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish. Coordinate hardware for automatic entrances with hardware required for rest of Project.

C. Electrical System Roughing-in: Coordinate layout and installation of automatic entrances with connections to power supplies and access-control system.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Transmit all action and informational submittal items together in one single complete submittal package for review.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for automatic entrances.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

C. Sustainable Design Submittals: Product data for sealants, indicating VOC content.

D. Shop Drawings: For automatic entrances, include project-specific shop drawings.

1. Include plans, elevations, sections, hardware mounting heights, and attachment details.
2. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Indicate locations of activation and safety devices.
5. Include hardware schedule and indicate hardware types, functions, quantities, and locations.
6. If manufacturer's sliding automatic entrances are not pre-engineered to meet performance requirements, Contractor's responsibility includes providing professional engineering services needed to assume engineering responsibility for sliding automatic entrances.

    a. Shop Drawings shall be signed and sealed by a California-licensed professional engineer responsible for their preparation, indicating compliance with performance requirements.

E. Aluminum Finish Samples: For each type of exposed finish required, in a representative section of each sliding automatic entrance, in manufacturer's standard size.

F. Glazing Samples: For each type of glazing indicated, 12 inches square and of same thickness indicated for the final Work.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For installer, manufacturer, and professional engineer.

B. Product Test Reports: For each type of automatic entrance, for tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranties: For manufacturer's special warranties.

1.8 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For automatic entrances, safety devices, and control systems to include in operation and maintenance manuals.

1.9 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of sliding automatic entrances that have been used for similar applications with successful results, that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports, labels, and calculations. Manufacturer shall have factory-authorized service representatives who are available for consultation, periodic Project-site observations, and on-site assistance.

B. Installer Qualifications: A firm with not less than 10 years' experience installing sliding automatic entrances similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

C. Certified Inspector Qualifications: Certified by AAADM.

D. Engineering Responsibility: If manufacturer's sliding automatic entrances are not pre-engineered to meet performance requirements, Contractor's responsibility includes providing professional engineering services needed to assume engineering responsibility for sliding automatic entrances.

1. Prepare data for sliding automatic entrances, including Shop Drawings, based on testing and engineering analysis for manufacturer's standard units in systems similar to those indicated for the Project and submission of reports of tests performed on manufacturer's standard assemblies, signed and sealed by the qualified California-licensed professional engineer responsible for their preparation.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard or customized warranty in which manufacturer and installer agrees to repair or replace components of automatic entrances that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.
b. Faulty operation of operators, controls, and hardware.
c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Period: Four years from date of Substantial Completion.

B. Special Finish Warranty: Manufacturer agrees to repair or replace components on which finishes fail in materials or workmanship within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide sliding automatic entrances by the following:

1. Stanley Access Technologies, LLC; Division of Stanley Security Solutions.

a. All Glass Units: "Dura-Glide All Glass Sliding Door System."

Or a Comparable Product by one of the following:

2. Besam Entrance Solutions; Subsidiary of ASSA ABLOY Entrance Systems.
3. Horton Automatics; a division of Overhead Door Corporation.

B. Source Limitations: Obtain sliding automatic entrances from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General: Provide sliding automatic entrances capable of complying with performance requirements indicated based on testing manufacturers' sliding doors that are representative of those specified.

1. Comply with the requirements of the 2016 CBC.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Power-Operated Door Standard: BHMA A156.10.

D. Drawings and Specifications: This Section provides a performance-based type of specification for the design, fabrication, and installation of the sliding automatic entrance system, including the glass and glazing. If the sliding automatic entrance system is not pre-engineered to meet the performance requirements, the Contractor is responsible for the engineering and design of all components and materials, as well as the fabrication, installation and performance of the system.

1. Drawings are diagrammatic. The details indicated are intended as a guide for the aesthetic and interfacing requirements of the sliding automatic entrance system with other Work. The details are intended to establish basic dimensions, locations, and different glass types. The Contractor is responsible for the system, including glass and glazing, within these aesthetic parameters. The drawings for the sliding automatic entrance system are not construed as being engineered, nor necessarily adequate to meet the engineering design requirements.
2. The design details do not cover all conditions which may be required for successful completion of the Work. Conditions not detailed shall be developed though the Contractor’s shop drawings, to the same level of aesthetics, and in compliance with the performance criteria, as indicated for detailed areas and as stipulated in these specifications. The Contractor, by accepting a contract for the Work, acknowledges this and agrees that the Architect and Owner’s representative shall have the final say as to all matters whether detailed or not on the design details.
3. For sliding automatic entrances that are not pre-engineered, comply with the following:

    a. Delegated Design: Design sliding automatic entrance system, including comprehensive engineering analysis data signed and sealed by a California-registered structural engineer, using performance requirements and design criteria indicated. Comply with requirements in Division 01 Section “Submittal Procedures” and as indicated on the Drawings.

E. Safety Glazing Standard: 16 CFR 1201 for heat treated and laminated glass, permanently marked with Safety Glazing Certification Council label. Comply with the 2016 CBC.

F. Structural Performance: Automatic entrances shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to the 2016 CBC.

1. Seismic Loads: Based on criteria indicated on the Structural Drawings.
2. Interior Lateral Loads: 5 lbf per square foot.

G. Operation: In compliance with Section 1010.1.4.3 of the 2016 CBC:

1. The door shall be power operated and shall be capable of being operated manually in the event of power failure.
2. The door shall be openable by a simple method from both sides without special knowledge or effort.
3. The force required to open the door shall not exceed 30 pounds to set the door in motion and 15 pounds to close the door or open it to the minimum required width.
4. The door shall be openable with a force not to exceed 15 pounds when a force of 250 pounds is applied perpendicular to the door adjacent to the operating device.
5. The door assembly shall have an integrated standyby power supply.
6. The doors assembly power supply shall be electronically supervised.
7. The door shall open to the minimum required width within 10 seconds after activation of the operating device.

H. Entrapment-Prevention Force:

1. Power-Operated Sliding Doors: Not more than 30 lbf required to prevent stopped door from closing.

2.3 SLIDING AUTOMATIC ENTRANCES

A. General: Provide manufacturer's standard automatic entrances including doors, sidelites, framing, headers, carrier assemblies, roller tracks, door operators, controls, and accessories required for a complete installation.

B. Configuration: Single-sliding doors with one sliding leaf and one fixed sidelite.

1. Traffic Pattern: Two way.
2. Emergency Breakaway Capability: As indicated on Drawings.
3. Mounting: Between jambs.

C. Operator Features:

1. Power opening and closing.
2. Drive System: Chain or belt.
3. Adjustable opening and closing speeds.
4. Adjustable hold-open time between zero and 30 seconds.
5. Obstruction recycle.
6. On-off/hold-open switch to control electric power to operator, key operated.

D. Sliding-Door Carrier Assemblies and Overhead Roller Tracks: Carrier assembly that allows vertical adjustment; consisting of nylon- or delrin-covered, ball-bearing-center steel wheels operating on a continuous roller track, or ball-bearing-center steel wheels operating on a nylon- or delrin-covered, continuous roller track. Support doors from carrier assembly by cantilever and pivot assembly.

1. Rollers: Minimum of two ball-bearing roller wheels and two antirise rollers for each active leaf.

E. Controls: Activation and safety devices according to BHMA standards.

1. Activation Device: Motion sensor mounted on each side of door header to detect pedestrians in activating zone and to open door. Provide optional push-plate switch and key switch on each side of door to activate door operator.
2. Safety Device: Presence sensor mounted to underside of door header and two photoelectric beams mounted in sidelite jambs on one side of the door to detect pedestrians in presence zone and to prevent door from closing.

F. Finish: Finish framing, door(s), and header with high-performance organic finish.

1. Color: Custom color to match Architect’s sample.

2.4 ENTRANCE COMPONENTS

A. Framing Members: Extruded aluminum, minimum 0.125 inch thick and reinforced as required to support imposed loads.

1. Nominal Size: In manufacturer’s standard size, engineered to meet performance requirements.
2. Extruded Glazing Stops and Applied Trim: Minimum 0.062-inch wall thickness.

B. All-Glass Sliding Doors: Fabricated from 13-mm-thick tempered glass, with polished vertical edges and minimum 0.125-inch-thick, extruded-aluminum top and bottom rails.

1. Rail Design: Manufacturer’s standard rail design, engineered to meet performance requirements.

a. Bottom Rail Design: 10-inch nominal height.

C. Sidelite(s): 1-3/4-inch-deep sidelite(s) with minimum 0.125-inch-thick, extruded-aluminum tubular rail members matching door design.

1. Glazing Stops and Gaskets: Same materials and design as for stile and rail door.

D. Headers: Fabricated from minimum 0.125-inch-thick extruded aluminum and extending full width of automatic entrance units to conceal door operators and controls. Provide hinged or removable access panels for service and adjustment of door operators and controls. Secure panels to prevent unauthorized access.

1. Mounting: Concealed, with one side of header flush with framing.
2. Capacity: Capable of supporting doors as indicated without intermediate supports.

E. Brackets and Reinforcements: High-strength aluminum with nonstaining, nonferrous shims for aligning system components.

F. Signage: As required by cited BHMA standard.

1. Application Process: Silk-screened.
2. Provide sign materials with instructions for field application after glazing is installed.

2.5 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Extrusions: ASTM B 221.
2. Sheet: ASTM B 209.

B. Steel Reinforcement: Reinforcement with corrosion-resistant primer complying with SSPC-PS Guide No. 12.00 applied immediately after surface preparation and pretreatment. Use surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

C. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
2. Minimum Thickness: As required to meet performance requirements, but no less than 13 mm (nominal 1/2 inch).
3. Grind smooth and polish exposed glass edges and corners.

D. Sealants and Joint Fillers: As specified in Section 079100 "Exterior Wall Joint Sealants."

E. Nonmetallic, Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout; complying with ASTM C 1107; of consistency suitable for application.

F. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

G. Fasteners and Accessories: Corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

2.6 DOOR OPERATORS AND CONTROLS

A. General: Provide operators and controls, which include activation and safety devices, according to BHMA standards, for condition of exposure, and for long-term, maintenance-free operation under normal traffic load for type of occupancy indicated.

B. Door Operators: Provide door operators of size recommended by manufacturer for door size, weight, and movement.

1. Door Operator Performance: Door operators shall open and close doors and maintain them in fully closed position when subjected to Project's design wind loads.
2. Electromechanical Operators: Concealed, self-contained, overhead unit powered by fractional-horsepower, permanent-magnet dc motor; with closing speed controlled mechanically by gear train and dynamically by braking action of electric motor; with solid-state microprocessor controller; UL 325; and with manual operation with power off.

C. Motion Sensors: Self-contained, K-band-frequency, microwave-scanner units; fully enclosed by its plastic housing; adjustable to provide detection-field sizes and functions required by BHMA A156.10.

1. Provide capability for switching between bidirectional and unidirectional detection.
2. For one-way traffic, sensor on egress side shall not be active when doors are fully closed.

D. Presence Sensors: Self-contained, active-infrared scanner units; adjustable to provide detection-field sizes and functions required by BHMA A156.10. Sensors shall remain active at all times.

E. Photoelectric Beams: Pulsed infrared, sender-receiver assembly for recessed mounting. Beams shall not be active when doors are fully closed.

F. Push-Plate Switch: Momentary-contact door-control switch with flat push-plate actuator with contrasting-colored, engraved message.

1. Configuration: Square push plate with 4-by-4-inch junction box.

a. Mounting: As indicated on Drawings, or if not indicated, recessed mounted, semiflush in wall.

2. Push-Plate Material: Stainless steel as selected by Architect from manufacturer's full range.
3. Message: International symbol of accessibility.

G. Key Switch: Recess-mounted, door-control switch with key-controlled actuator; enclosed in 2-by-4-inch junction box. Provide faceplate engraved with letters indicating switch functions.

1. Face-Plate Material: Stainless steel as selected by Architect from manufacturer's full range.
2. Functions: Two-way automatic, hold open, one-way exit, and off.
3. Mounting: As indicated on Drawings, or if not indicated, recess mounted, semiflush in wall.

H. Electrical Interlocks: Unless units are equipped with self-protecting devices or circuits, provide electrical interlocks to prevent activation of operator when door is locked, latched, or bolted.

I. Electrical Supervision: The door assembly power supply shall be electrically supervised in compliance with the 2016 CBC.

J. Standby Power Supply: Provide uninterruptible standby power supply with extended operation in compliance with the 2016 CBC.

2.7 HARDWARE

A. General: Provide units in sizes and types recommended by automatic entrance and hardware manufacturers for entrances and uses indicated. Finish exposed parts to match door finish.

B. Breakaway Device for Power-Operated Doors: Device that allows door to swing out in direction of egress to full 90 degrees from any operating position. Maximum force to open door shall be as stipulated in "Performance Requirements" Article. Interrupt powered operation of door operator while in breakaway mode.

C. Deadlocks: Deadbolt operated by exterior cylinder and interior thumb turn, with minimum 1-inch-long throw bolt; BHMA A156.5, Grade 1.

1. Deadbolts: Laminated-steel hook, mortise type, BHMA A156.5, Grade 1.
2. Cylinders: As specified in Section 087100 "Door Hardware."

a. Keying: Integrate into building master key system.

D. Dustproof Strikes for All-Glass Sliding Doors: Recessed, floor-type, BHMA A156.16, Grade 1, to receive deadbolt.

E. Stripping: Replaceable components.

1. Sliding Type: AAMA 701, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

F. Sweeps: Manufacturer’s standard adjustable nylon brush sweep mounted to underside of door bottom.

2.8 FABRICATION

A. General: Factory fabricate automatic entrance components to designs, sizes, and thicknesses indicated and to comply with indicated standards.

1. Form aluminum shapes before finishing.
2. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
3. Use concealed fasteners to greatest extent possible. Where exposed fasteners are required, use countersunk Phillips flat-head machine screws, finished to match framing.

a. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
b. Reinforce members as required to receive fastener threads.

4. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.

B. Framing: Provide automatic entrances as prefabricated assemblies. Complete fabrication, assembly, finishing, hardware application, and other work before shipment to Project site.

1. Fabricate tubular and channel frame assemblies with welded or mechanical joints. Provide subframes and reinforcement as required for a complete system to support required loads.
2. Perform fabrication operations in manner that prevents damage to exposed finish surfaces.
3. Form profiles that are sharp, straight, and free of defects or deformations.
4. Provide components with concealed fasteners and anchor and connection devices.
5. Fabricate components with accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion.
6. Fabricate exterior components to drain condensation and water passing joints within system to the exterior.
7. Provide anchorage and alignment brackets for concealed support of assembly from building structure.
8. Allow for thermal expansion of exterior units.

C. Doors: Factory fabricated and assembled in profiles indicated. Reinforce as required to support imposed loads and for installing hardware.

D. Metal Cladding: Factory-fabricated and installed metal cladding, completely covering all visible surfaces as part of prefabricated entrance assembly before shipment to Project site.

1. Perform fabrication operations in manner that prevents damage to exposed finish surfaces.
2. Form profiles that are sharp, straight, and free of defects or deformations.
3. Provide components with concealed fasteners and anchor and connection devices.
4. Fabricate components with accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion.
5. Fabricate exterior components to drain water passing joints and condensation and moisture occurring or migrating within system to the exterior.
6. Allow for thermal expansion at exterior entrances.

E. Door Operators: Factory fabricated and installed in headers, including adjusting and testing.

F. Glazing: Fabricate framing with minimum glazing edge clearances for thickness and type of glazing indicated, according to GANA's "Glazing Manual."

G. Hardware: Factory install hardware to greatest extent possible; remove only as required for final finishing operation and for delivery to and installation at Project site. Cut, drill, and tap for factory-installed hardware before applying finishes.

1. Provide sliding-type stripping, mortised into door, at perimeter of doors.

H. Controls:

1. General: Factory install activation and safety devices in doors and headers as required by BHMA A156.10 for type of door and direction of travel.
2. Install photoelectric beams in vertical jambs of sidelites, with dimension above finished floor as follows:

a. Top Beam: 48 inches.
b. Bottom Beam: 24 inches.

2.9 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.10 ALUMINUM FINISHES

A. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Finish: Custom to match Architect’s sample.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances, header support, and other conditions affecting performance of automatic entrances.

B. Examine roughing-in for electrical systems to verify actual locations of power connections before automatic entrance installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install automatic entrances according to manufacturer's written instructions and cited BHMA standard for direction of pedestrian travel, including signage, controls, wiring, and connection to the building's power supply.

1. Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints.
2. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
3. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous coating.

B. Entrances: Install automatic entrances plumb and true in alignment with established lines and grades without warp or rack of framing members and doors. Anchor securely in place.

1. Install surface-mounted hardware using concealed fasteners to greatest extent possible.
2. Set headers, carrier assemblies, tracks, operating brackets, and guides level and true to location with anchorage for permanent support.
3. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within system to exterior.
4. Level recesses for recessed thresholds using nonshrink grout.

C. Door Operators: Connect door operators to electrical power distribution system.

D. Access-Control Devices: Connect access-control devices to access-control system as specified in Section 281300 "Access Control."

E. Controls: Install and adjust activation and safety devices according to manufacturer's written instructions and cited BHMA standard for direction of pedestrian travel. Connect control wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

F. Guide Rails: Install rails according to BHMA A156.10, including Appendix A, and manufacturer's written instructions unless otherwise indicated.

G. Glazing: Install glazing for all-glass units in accordance with manufacturer’s written instructions.

H. Sealants: Comply with requirements specified in Section 079200 "Joint Sealants."

1. Seal perimeter of framing members with sealant.

I. Signage: Apply signage on both sides of each door as required by cited BHMA standard for direction of pedestrian travel.

J. Wiring within Automatic Entrance Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's written limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 FIELD QUALITY CONTROL

A. Certified Inspector: Engage a Certified Inspector to test and inspect components, assemblies, and installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Test and inspect each automatic entrance, using AAADM inspection forms, to determine compliance of installed systems with applicable BHMA standards.

C. Automatic entrances will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust hardware, moving parts, door operators, and controls to function smoothly, and lubricate as recommended by manufacturer; comply with requirements of applicable BHMA standards.

B. Readjust door operators and controls after repeated operation of completed installation equivalent to three days' use by normal traffic (100 to 300 cycles).

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.5 CLEANING

A. Clean glass and metal surfaces promptly after installation. Remove excess glazing and sealant compounds, dirt, and other substances. Repair damaged finish to match original finish.

1. Comply with requirements in Section 088000 "Glazing" for cleaning and maintaining glass.

3.6 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of automatic entrance Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper automatic entrance operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Engage a Certified Inspector to perform safety inspection after each adjustment or repair and at end of maintenance period. Furnish completed inspection reports to Owner.
2. Perform maintenance, including emergency callback service, during normal working hours.
3. Include 24-hour-per-day, 7-day-per-week, emergency callback service.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain automatic entrances.

END OF SECTION 084229

SECTION 084329 - SLIDING GLASS STOREFRONTS (DEFERRED APPROVAL)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes exterior sliding glass storefronts.

B. Work under this Section is part of a “Deferred Approval.” Coordinate with the deferred approval requirements in Section 013300 “Submittal Procedures” and with the requirements indicated on the Drawings.

1. Contract Drawings are Diagrammatic: The details shown are intended as a guide for the aesthetic and interfacing requirements other various components of the exterior wall to and with other work; details are intended to establish basic dimensions of the module and the sight lines, jointing and profiles of members. Contractor is responsible for the design and engineering of the system within these aesthetic parameters. The drawings are not to be construed as engineering design, or adequate to meet the engineering design requirements.
2. Design conditions not included in Contract Drawings shall be developed through the Contractor's shop drawings in compliance with these specifications. Architect shall have the final say as to all matters whether detailed or not on the architectural design details.

C. Related Requirements:

1. Section 055000 "Metal Fabrications" for steel not provided as part of this Section.
2. Section 072713 "Modified Bituminous Sheet Air Barriers" for coordination and continuity of air/weather barrier with sliding glass storefronts provided under this Section.
3. Section 079200 "Joint Sealants" for installation of joint sealants installed with aluminum-framed entrances and storefronts.
4. Section 084413 "Glazed Aluminum Curtain Walls and Entrances" for coordinating finish among aluminum fenestration units on the building exterior.
5. Section 087100 "Door Hardware" for hardware to the extent not specified herein.
6. Section 088000 "Glazing" for glass to be installed in sliding glass storefronts.
7. Division 22 Section(s) and/or Division 32 Section(s) for connections to weep systems from ADA-compliant thresholds.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Construction Manager, Architect, envelope consultant, inspection agency, installer, manufacturer's technical representative, and other installers whose work interfaces with sliding glass storefronts.
2. Review the following:

a. Contract Document requirements.
b. Reviewed submittals.
c. Installation procedures.
d. Inspection and testing.
e. Forecasted weather conditions and procedures for coping with unfavorable conditions.
f. Tour representative areas of required work, discuss and evaluate for compliance with Contract Documents and approved submittals, including substrate conditions, surface preparations, sequence of installation and other preparatory work performed by other installers.

3. Contractor shall prepare minutes of preinstallation conference and distribute to participants.

1.4 ACTION SUBMITTALS

A. Transmit all action and informational submittal items together in one single complete submittal package for review.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions.

C. Sustainable Design Submittals: Product data for sealants, indicating VOC content.

D. Shop Drawings: For sliding glass storefronts.

1. Include plans, elevations, sections, and details.
2. Detail attachments to other work, and between units, if any.
3. Indicate sealant joints, including locations, sizes, and types.
4. Include hardware and required clearances.
5. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
6. Shop Drawings shall be stamped and signed by the California-licensed professional engineer responsible for their preparation, including analysis data, indicating compliance with performance requirements.

E. Samples for Initial Selection: For units with factory-applied finishes.

F. Samples for Verification: For sliding glass storefronts and components required, prepared on Samples of size indicated below:

1. Main Framing Member: 12-inch-long section with weather stripping, glazing bead, and factory-applied color finish.
2. Hardware: Full-size units with factory-applied finish.
3. Exposed Finishes: For each exposed product and for each color specified, 2 by 4 inches in size.
4. Glazing: For each type of glass, 12 inch square.

G. Deferred-Approval Submittal: For sliding glass storefronts indicated to comply with performance requirements and design criteria, including shop drawings, calculations, and analysis data stamped and signed by the qualified California-licensed professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, manufacturer, field testing agency, and professional engineer.

B. Energy Performance Certificates: For sliding glass storefronts, accessories, and components from manufacturer.

1. Basis for Certification: NFRC-certified energy performance values for each glazed aluminum curtain wall. Provide evidence that proposed systems meets “Envelope Mandatory Measures” (ENV-1).

C. Product Test Reports: For each sliding glass storefront, for tests performed by a qualified testing agency.

D. Welding certificates.

E. Field quality-control reports.

F. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes, weather stripping, operable panels, and operating hardware to include in maintenance manuals.

B. Record Shop Drawings: Record actual installation that varies from that shown originally, giving particular attention to concealed components that would be difficult to identify later; comply with Section 017839 "Project Record Documents."

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of sliding glass storefronts that have been used for similar applications with successful results, that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports, labels, and calculations. Manufacturer shall have factory-authorized service representatives who are available for consultation, periodic Project-site observations, and on-site assistance.

B. Installer Qualifications: A firm with not less than 10 years' experience installing sliding glass storefronts similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

C. Engineering Responsibility: Prepare data for sliding glass storefronts, including Shop Drawings, based on testing and engineering analysis for manufacturer's standard units in systems similar to those indicated for the Project and submission of reports of tests performed on manufacturer's standard assemblies, signed and sealed by the qualified California-licensed professional engineer responsible for their preparation.

D. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.

E. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code - Steel."
2. AWS D1.2, "Structural Welding Code - Aluminum."

F. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockup for sliding glass storefront system, as shown on Drawings, or if not shown for first module of sliding glass storefront system.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

G. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.
2. Performance characteristics are indicated by criteria subject to verification by one or more methods, including preconstruction testing, field testing, and in-service performance.

1.8 COORDINATION

A. Coordinate sliding glass storefront installation with flashing, trim, curtain walls, metal composite material wall panels, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1. Coordinate installation of weep system associated with the ADA-compliant threshold, whether indicated or not, with Division 22 Section(s) and/or Division 32 Section(s) to comply with performance requirements.

B. Coordinate installation of miscellaneous metal sub-framing, anchorage items, or other items to be embedded in or attached to other construction before starting that Work. Provide locations, setting diagrams, templates, instructions, and directions for installation. Deliver such items to Project site in time for installation.

C. Pre-Installation Field Measurements: Coordinate exact hardware and anchorage locations with other Trade Contractors before permanently attaching to other construction.

D. Post-Installed Field Measurements: Field verify and examine actual installed locations of connection hardware and anchorage items prior to installation of Work provided under this Section. Notify General Contractor and Architect immediately of any discrepancies in writing. Provide letter from sliding glass storefront installer indicating acceptance of connection hardware and anchorage items.

1.9 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer’s standard or customized form in which manufacturer and installer agree to repair or replace components of sliding glass storefronts that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure to meet performance requirements.
b. Structural failures including excessive deflection.
c. Excessive water leakage or air infiltration.
d. Faulty operation of movable panels and hardware.
e. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
f. Failure of insulating glass.

2. Warranty Period:

a. Sliding Door: 10 years from date of Substantial Completion.
b. Insulating-Glass Units: 10 years from date of Substantial Completion.
c. Aluminum Finish: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide sliding glass storefronts by the following:

1. Nana Wall Systems, Inc.; HSW 60 with ADA-compliant low-profile saddle sill.

Or a Comparable Equal by one of the following:

2. Panda Windows and Doors; "Lift and Slide" All Aluminum (IS.14).

B. Source Limitations: Obtain sliding glass storefronts from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Deferred-Approval Engineering Responsibility: Engage a qualified California-licensed professional engineer, as defined in Section 014000 "Quality Requirements," to engineer sliding glass storefronts.

B. General Performance: Comply with performance requirements specified, as determined by testing of sliding glass storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Sliding glass storefronts shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads, wind and seismic loads.
2. Sliding glass storefronts shall accommodate tolerance in construction, including, but not limited to, those from structural frame tolerances, manufacturing tolerances, and field installation tolerances.
3. Failure also includes the following:

a. Structural failures including, but not limited to, deflection exceeding specified limits.
b. Thermal stresses transferring to building structure.
c. Glass breakage.
d. Noise or vibration created by wind and thermal and structural movements.
e. Loosening or weakening of fasteners, attachments, and other components.
f. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
g. Water penetration through fixed glazing and framing areas.
h. Glazing to glazing contact.
i. Sealant failures.
j. Framing members transferring stresses to glazing, including those caused by thermal and structural movements.

4. Sliding glass storefronts shall comply with the 2016 California Building Code (CBC) and the 2016 California Energy Code (CEC)

C. Structural Performance (Exterior Units): Provide sliding glass storefront system capable of withstanding the effects of the following loads and stresses within limits and under conditions indicated, based on testing units representative of those indicated for Project that pass ASTM E 330:

1. Wind Loads: As indicated on Drawings.
2. Seismic Loads: As indicated on Drawings.
3. Deflection Limits: Design glass framing system to limit lateral deflections of glass edges to less than 1/175 of glass-edge length or 3/4 inch, whichever is less, at design pressure based on testing performed according to AAMA/WDMA/CSA 101/I.S.2/A440, Uniform Load Deflection Test, or structural computations.

D. Interstory Drift: Accommodate design displacement of adjacent stories indicated.

1. Elastic and Inelastic Displacements: As indicated on Structural Drawings.
2. Test Performance: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.4 at elastic displacement and inelastic displacement.

E. Seismic Performance: Sliding glass storefronts shall withstand the effects of earthquake motions determined according to the 2016 California Building Code.

1. Seismic Drift Causing Glass Fallout: Complying with criteria for passing based on building occupancy type at elastic displacement and inelastic displacement when tested according to AAMA 501.6 or by engineering analysis.

F. Air Infiltration: Test according to ASTM E 283: Maximum air leakage of 0.30 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft.

G. Water Penetration under Static Pressure): Test according to ASTM E 331, ASTM E 547: No uncontrolled water leakage at a static test pressure of 6.00 lbf/sq. ft.

H. Energy Performance: Certify and label energy performance according to NFRC as follows:

1. Thermal Transmittance of Sliding Glass Storefronts: In compliance with project's "Envelope Mandatory Measures" (ENV-1).
2. Solar Heat Gain Coefficient: In compliance with project's "Envelope Mandatory Measures" (ENV-1).
3. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC-certified condensation resistance rating of no less than 45 as determined according to NFRC 500.
4. Continuity of Air Barrier: Provide a complete and uninterrupted air barrier separate from or combined with the other wall barrier systems.

I. Thermal Movements: Provide sliding glass storefronts, including anchorage, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

J. Accessibility Requirements: Comply with applicable provisions in the 2010 ADA Standards for Accessible Design and the accessibility requirements of the 2016 CBC for door hardware on doors in an accessible route.

1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
2. Comply with the following maximum opening-force requirements:

    a. Exterior and Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.

3. Provide thresholds not more than 1/2 inch high. Changes in level between 1/4 inch high minimum and 1/2 inch high maximum shall be beveled with a slope not steeper than 1:2.
4. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch.
5. Door closers and stops shall not reduce headroom to less than 78 inches.
6. Floor-mounted door stops and other similar obstructions shall be installed 4 inches maximum from the face of the wall or partition. Floor stops shall not be located in the path of travel.
7. Panic hardware shall be mounted between 36 inches and 44 inches above finished floor such that the clear width of the exitway is not less than 32 inches measured between the face of the door and the opposite stop. The unlatching force of panic hardware shall not exceed 5 lbs, applied in the direction of travel.
8. Swinging door surfaces within 10 inches of the finish floor or ground surface measured vertically shall have a smooth surface on the push side extending the full width of the door.

2.3 SLIDING GLASS STOREFRONTS

A. Thermally-Broken Aluminum-Framed Sliding Glass Storefront Description: 2-3/8 inch wide narrow-stile frame, with ADA-compliant low-profile saddle sill threshold. Manufacturer’s standard or post reinforced frame and panel profiles, with head track, side jambs and panels with dimensions as shown on Drawings.

B. Frames and Door Panels: Fabricated from aluminum extrusions complying with 6063-T5.

1. Thermally Broken Construction: Fabricate frames and door panels with an integral, concealed, low-conductance thermal barrier located between exterior and interior surfaces in a manner that eliminates direct metal-to-metal contact.
2. Aluminum Extrusion Thickness: Minimum 0.078 inch nominal.

C. Low-Profile Saddle Sill Threshold: Provide ADA-compliant extruded-aluminum threshold and track of thickness, dimensions, and profile indicated; designed to comply with performance requirements. Provide in finish closest match to finish of frame and panels. At exterior units, threshold shall be weather resistant and shall drain to the exterior. See "Coordination" Article above.

2.4 GLAZING

A. Exterior Units: Low-E-coated, fully-tempered and heat soaked, insulated glass, nominal 1-inch thick, as indicated on Drawings and as specified in Section 088000 "Glazing."

2.5 HARDWARE

A. General: Provide manufacturer's standard hardware, fabricated from a corrosion-resistant material compatible with aluminum complying with AAMA 907 and designed to smoothly operate, tightly close, and securely lock sliding glass storefronts.

B. Sliding and Swinging Hardware: Provide manufacturer's standard hardware.

1. For each sliding panel, provide 2 two-three wheeled, sintered bronze (oil impregnated) unidirectional sliding panel carriers that are attached to the panels with stainless steel rods. Maximum carrying capacity of two carriers on a panel to be 330 lbs.
2. Main Entry Panels for Models with a Swing Panel and Exit Device: Provide manufacturer's standard exterior pull handles in a brushed stainless steel finish, and other hardware as specified in Section 087100 "Door Hardware," including, but not limited to, exit devices (with concealed rods to top and bottom), cylinders, closers. Exit devices with face-applied vertical rods are not acceptable.
3. Sliding Panel to be Opened First for Models WITHOUT a Swing Panel: Provide manufacturer's standard L-shaped handle on the inside, flat handle on the outside and lock set with profile cylinder. Operation of lockset is by turn of key from the outside and with a thumb-turn from the inside with a two point locking hardware operated by 180º turn of the handle.
4. Secondary Panels: Provide manufacturer's standard flat handles and concealed two-point locking hardware operated by 180º turn of the handle. Face-applied flush bolt locking is not acceptable.
5. Adjustment: Provide system capable of specified amount of adjustments without removing panels from tracks.

C. Threshold: Low-profile ADA-compliant thresholds; self-draining and weather-resistant at exterior locations. Provide in finish closest match to finish of frame and panels.

D. Weatherstripping (Exterior Units): Provide manufacturer's standard double layer APTK at both the inner and outer edge of door panels or on frame for vertical sealing between panels and between panels and frame. Provide brush seals with flexible plastic web for all horizontal sealing. Single layer weather stripping will not be allowed.

E. Fasteners: Stainless steel machine screws for connecting frame components.

F. Hardware Finish: As indicated on Drawings, or if not indicated, as selected by Architect from manufacturer's full range of standard and optional finishes.

2.6 ACCESSORIES

A. Fasteners: Noncorrosive and compatible with door members, trim, hardware, anchors, and other components.

1. Exposed Fasteners: Do not use exposed fasteners to the greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

B. Anchors, Clips, and Accessories: Provide anchors, clips, and accessories of aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron for sliding glass storefronts, complying with ASTM B 456 or ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.

2.7 FABRICATION

A. Fabricate sliding glass storefronts in sizes indicated. Include a complete system for assembling components and anchoring doors.

B. Fabricate sliding glass storefronts that are reglazable without dismantling panel framing.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
6. All exposed surfaces shall be finished.

D. Weather Stripping: Provide full-perimeter weather stripping for each sliding panel.

E. Weep Holes: Provide weep holes and internal drainage passages to conduct infiltrating water to exterior.

F. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.

G. Factory-Glazed Fabrication: Glaze sliding glass storefronts in the factory where practical and possible for applications indicated. Comply with requirements in Section 088000 "Glazing" and with AAMA/WDMA/CSA 101/I.S.2/A440.

2.8 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.9 ALUMINUM FINISHES

A. High-Performance Organic Finish: Three-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: Custom color to match Architect's sample.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify rough opening dimensions, levelness of threshold substrate, and operational clearances.

C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated, weathertight sliding glass storefront installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing sliding storefront system, hardware, accessories, and other components. Commence installation in presence of manufacturer’s technical representative.

B. Install sliding glass storefronts level, plumb, square, true to line, without distortion, without warp or rack of frames and panels, and without impeding thermal movement; anchored securely in place to structural support; and in proper relation to wall flashing, vapor retarders, air barriers, water/weather barriers, and other adjacent construction.

C. Set sill members in bed of sealant or with gaskets, as indicated, to provide weathertight construction. Provide connections to allow for drainage.

D. Install sliding glass storefronts and components to drain condensation, water penetrating joints, and moisture migrating within doors to the exterior.

E. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

F. Install glazing as specified in Section 088000 “Glazing.”

G. Install panels, handles, lock sets, weather-stripping, and other accessories in accordance with manufacturer’s written instructions.

3.3 FIELD QUALITY CONTROL (BY OWNER)

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Field and shop welds in compliance with CBC 1705.2.
2. Post-installed concrete anchors in compliance with CBC 1705.3.
3. Exterior cladding in compliance with CBC 1705.12.5.

B. Sliding glass storefronts will be considered defective if they do not pass tests and inspections.

C. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

E. Prepare test and inspection reports.

3.4 FIELD QUALITY CONTROL (BY CONTRACTOR)

A. Manufacturer's Field Service: Contractor shall engage a manufacturer's technical representative for technical assistance and guidance for installation of sliding glass storefronts. At a minimum, arrange for manufacturer's technical representative to observe installation of storefront system during initial installation, at mid-point of the installation, and at completion. Provide additional field observation as required to obtain warranty specified and when requested by Architect or Owner. After each field visit, submit manufacturer's written report of observations within 3 working days. The report shall note overall quality of work, deficiencies, and any other concerns, and recommend corrective action.

B. Testing Agency: Engage a qualified testing agency to perform test and inspections.

C. Field Quality-Control Testing (Exterior Units): Perform the following test on representative areas of sliding glass storefronts.

1. Water Penetration Test (Chamber Test): Before installation of interior finishes has begun, conduct tests in accordance with ASTM E 1105. No uncontrolled water leakage is permitted when tested at a static test pressure of two-thirds the specified water penetration pressure, but not less than 12 psf for fixed glazing and reduced pressure applicable for door performance.

    a. Test Areas and Locations: As determined by Envelope Consultant.
    b. Frequency: At 10 and 35 percent completion.

D. Sliding glass storefronts will be considered defective if they do not pass tests and inspections.

E. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.

F. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

G. Prepare test and inspection reports.

3.5 MAINTENANCE SERVICE

A. Hardware:

1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of sliding glass storefront.
2. Initial Maintenance Service: Beginning at Substantial Completion, provide twelve (12) months' full maintenance by skilled employees of entrance door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Use parts and supplies that are the same as those used in the manufacture and installation of original equipment.

3.6 ADJUSTING, CLEANING, AND PROTECTION

A. Lubricate hardware and moving parts.

B. Adjust operating panels to provide a tight fit at contact points and weather stripping for smooth operation, without binding, and a weathertight closure. Adjust hardware for proper alignment, smooth operation, and proper latching without unnecessary force or excessive clearance.

1. Adjust hardware to comply with accessibility requirements in "Performance Requirements" Article.

C. Clean exposed surfaces immediately after installing sliding glass storefronts. Avoid damaging protective coatings and finishes. Remove nonpermanent labels, excess sealants, glazing materials, dirt, and other substances.

D. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

E. Protect sliding glass storefront surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances contact sliding glass storefront surfaces, remove contaminants immediately according to manufacturer's written instructions.

F. Refinish or replace sliding glass storefronts with damaged finishes.

G. Replace damaged components.

H. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 084329

SECTION 084413 - **GLAZED ALUMINUM CURTAIN WALLS AND ENTRANCES (DEFERRED APPROVAL)**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Glazed aluminum curtain walls.
2. Exterior manual-swing entrance doors.
3. Sun control systems and mullion extensions.
4. Anchorages provided per this Section and installed under other Section(s).
5. Field testing.

B. Work under this Section is part of a "Deferred Approval." Coordinate with the deferred approval requirements in Section 013300 "Submittal Procedures" and with the requirements indicated on the Drawings.

1. Contract Drawings are Diagrammatic: The details shown are intended as a guide for the aesthetic and interfacing requirements other various components of the exterior wall to and with other work; details are intended to establish basic dimensions of the module and the sight lines, jointing and profiles of members. Contractor is responsible for the design and engineering of the system within these aesthetic parameters. The drawings are not to be construed as engineering design, or adequate to meet the engineering design requirements.
2. Design conditions not included in Contract Drawings shall be developed through the Contractor's shop drawings in compliance with these specifications. Architect shall have the final say as to all matters whether detailed or not on the architectural design details.
3. The curtain wall systems and interface details between the curtain wall systems and adjacent envelope components shall be designed utilizing rainscreen principles.

    a. Two distinct lines of protection against water ingress shall be provided, with the interior line of protection providing the primary air barrier of the system.

        1) The air and water seal shall extend from the curtain wall frame to appropriate air and water barrier of the adjacent system.
        2) The exterior weather seal or flashing shall extend from the exterior of the curtain wall system to the exterior cladding or similar water shedding surface of the adjacent construction.

    b. Provide weeps to allow drainage to the exterior of water, which enters the space between the interior and exterior seals. Where feasible, provide drainage to the exterior at horizontal mullions below each glazing unit, or at stack joints. Unless otherwise indicated or approved by the Architect, drainage paths shall be concealed or similarly protected from direct exposure to wind-driven rain.

C. Related Requirements:

1. Section 033000 "Cast-In-Place Concrete" for embedment of anchorage embeds or clips.
2. Section 055000 "Metal Fabrications" for steel not provided as part of this Section.
3. Section 072100 "Thermal Insulation" for perimeter fire containment insulation and insulation behind spandrel glazing and panels.
4. Section 072713 "Modified Bituminous Sheet Air Barriers" for coordination and continuity of air/weather barrier with curtain walls and entrances provided under this Section.
5. Section 079200 "Joint Sealants" for installation of joint sealants installed with glazed aluminum curtain walls and for sealants to the extent not specified in this Section.

6. Section 084426 "Point-Supported Glazing Systems" for point-supported glazing assemblies.
7. Section 087100 "Door Hardware" for door hardware other than that provided under this Section.
8. Section 088000 "Glazing" for glass to be installed in aluminum curtain walls and entrances.
9. Division 26 and/or 28 Section(s) for wiring of aluminum-framed storefronts.

1.3 DEFINITIONS

A. AAMA: Architectural Aluminum Manufacturers Association

1. AAMA 501.2, Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems
2. AAMA 503, Voluntary Specification for Field Testing of Storefronts, Curtain Walls and Sloped Glazing Systems. No pressure reduction allowed. Design pressures as specified herein.
3. AAMA 609 & 610, Voluntary Guide Specification for Cleaning and Maintenance of Painted Aluminum Extrusions and Curtain Wall Panels

B. ASTM: American Society for Testing and Materials

1. ASTM E 331: Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
2. ASTM E 1105: Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference.
3. ASTM A570 / A611, Specifications for Steel and Structural Steel.
4. ASTM A743, Specification for Castings, Iron Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.

C. CBC: 2016 California Building Code

D. CEC: 2016 California Energy Code.

E. GANA - Glass Association of North America.

1. GANA (GM) - GANA Glazing Manual.
2. GANA (SM) - FGMA Sealant Manual.

F. Water Penetration:

1. Uncontrolled: Infiltrated water that is not captured, controlled or managed to drain to exterior; water that wets perimeter containment system, wall insulation, or normally exposed interior surfaces.
2. Controlled: Infiltrated water that is captured, controlled or managed by flashings, gutters, and sills to drain to exterior; water that does not wet perimeter containment system, wall insulation, or normally exposed interior surfaces.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Construction Manager, Architect, envelope consultant, inspection agency, installer, manufacturer's technical representative, and other installers whose work interfaces with glazed aluminum curtain walls and entrances.
2. Review the following:

a. Contract Document requirements.
b. Reviewed submittals.
c. Installation procedures.
d. Inspection and testing.
e. Forecasted weather conditions and procedures for coping with unfavorable conditions.
f. Tour representative areas of required work, discuss and evaluate for compliance with Contract Documents and approved submittals, including substrate conditions, surface preparations, sequence of installation and other preparatory work performed by other installers.

3. Contractor shall prepare minutes of preinstallation conference and distribute to participants.

1.5 ACTION SUBMITTALS

A. Transmit all action and informational submittal items together in one single complete submittal package for review.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include manufacturer's printed installation instructions.

C. Sustainable Design Submittals: Product data for sealants, indicating VOC content.

D. Shop Drawings: Provide project-specific shop drawings for glazed aluminum curtain walls and entrances consisting of plans, elevations, sections, full-size details, and attachments to other work.

1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
2. Include full-size isometric details of each vertical-to-horizontal intersection of glazed aluminum curtain walls, showing the following:

a. Joinery, including concealed welds.
b. Anchorage.
c. Embeds and Clips: Contractor shall be responsible for design, engineering, coordination, layout, and checking embeds and clips. Embedded anchors shall be installed in accordance with approved curtain wall Contractor's embedment drawings and shall comply with the drawings indicated in the Contract Documents. Steel clips, angles, tubes, or other window wall attachments devices shall be furnished by the curtain wall Contractor.
d. Expansion provisions.
e. Indicate sealant joints, including locations, sizes, and types.
f. Glazing.
g. Flashing and drainage.

3. Show connection to and continuity with adjacent air/weather/waterproofing barriers.
4. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations. Coordinate with Section 087000 "Door Hardware."
5. Shop drawings shall be stamped and signed by the California-licensed professional engineer responsible for their preparation, including analysis data, indicating compliance with performance requirements.

E. Samples for Initial Selection: For units with factory-applied color finishes.

F. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

G. Samples for Glazing: For each type of glass, 12 inch square.

H. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

I. Deferred-Approval Submittal: For glazed aluminum curtain walls and entrances indicated to comply with performance requirements and design criteria, including shop drawings, calculations, and analysis data stamped and signed by the qualified California-licensed professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer, installer, professional engineer, and field testing agency.

1. Provide statement from manufacturer indicating installer is certified to install specified products.

B. Energy Performance Certificates: For glazed aluminum curtain walls, accessories, and components from manufacturer.

1. Basis for Certification: NFRC-certified energy performance values for each glazed aluminum curtain wall. Provide evidence that proposed systems meets “Envelope Mandatory Measures” (ENV-1).

C. Product Test Reports: For glazed aluminum curtain walls, for tests performed by a qualified testing agency.

1. If test reports are not available, system shall be laboratory tested.
2. Proposed deviations without test reports will not be considered.
3. Material products provided by overseas manufacturers shall be domestically tested and approved by local governing bodies. Contractor shall provide evidence of tests and certifications performed.

D. Fastener and Anchor Test Reports: Certified reports of last completed set of mechanical test for each device.

E. Welding certificates.

F. Field quality-control reports.

G. Sample Warranties: For special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For glazed aluminum curtain walls to include in maintenance manuals.

B. Maintenance Data for Structural Sealant: For structural-sealant-glazed curtain walls to include in maintenance manuals. Include ASTM C 1401 recommendations for post-installation-phase quality-control program.

C. Record Shop Drawings: Record actual installation that varies from that shown originally, giving particular attention to concealed components that would be difficult to identify later; comply with Section 017839 "Project Record Documents."

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 20 years’ experience regularly engaged in the production and sales of glazed aluminum curtain walls and entrances that have been used for similar applications with successful results, that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports, labels, and calculations. Manufacturer shall have factory-authorized service representatives who are available for consultation, periodic Project-site observations, and on-site assistance.

B. Installer Qualifications: A firm with not less than 10 years’ experience installing glazed aluminum curtain walls and entrances similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

C. Engineering Responsibility: Prepare data for glazed aluminum curtain walls and entrances, including Shop Drawings, based on testing and engineering analysis for manufacturer's standard units in systems similar to those indicated for the Project and submission of reports of tests performed on manufacturer's standard assemblies, signed and sealed by the qualified California-licensed professional engineer responsible for their preparation.

D. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.

E. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code - Steel."
2. AWS D1.2, "Structural Welding Code - Aluminum."

F. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.
2. Performance characteristics are indicated by criteria subject to verification by one or more methods, including preconstruction testing, field testing, and in-service performance.
3. Sealant joints over 1 inch wide, within or adjacent to curtain wall assemblies, are not acceptable. Refer to performance requirements in Section 079200 "Joint Sealants."
4. Glazed aluminum curtain wall system shall be so designed that defective or damaged glass, panels, and/or other components can be easily dismantled and replaced without causing damage to other parts of the building.

G. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Description: Incorporate glazed aluminum curtain wall mockup into integrated exterior mockup per Section 014000 "Quality Requirements."
2. Construct mockup in presence of manufacturer's technical representative.
3. Testing shall be performed on mockups according to requirements in "Field Quality Control" Article.
4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.9 COORDINATION

A. Coordinate glazed aluminum curtain wall and entrance installation with flashing, trim, parapets, storefronts, wall panels, louvers, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

B. Coordinate installation of miscellaneous metal sub-framing, anchorage items, or other items to be embedded in or attached to other construction before starting that Work. Provide locations, setting diagrams, templates, instructions, and directions for installation. Deliver such items to Project site in time for installation.

C. Pre-Installation Field Measurements: Coordinate exact hardware and anchorage locations with other Trade Contractors before permanently attaching to other construction.

D. Post-Installed Field Measurements: Field verify and examine actual installed locations of connection hardware and anchorage items prior to installation of Work provided under this Section. Notify General Contractor and Architect immediately of any discrepancies in writing. Provide letter from curtain wall installer indicating acceptance of connection hardware and anchorage items.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard or customized form in which manufacturer and installer agree to repair or replace components of glazed aluminum curtain wall and entrances that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, deflection exceeding specified limits.
b. Thermal stresses transferring to building structure.
c. Glass breakage.
d. Noise or vibration created by wind and thermal and structural movements.
e. Loosening or weakening of fasteners, attachments, and other components.
f. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
g. Water penetration through fixed glazing and framing areas.
h. Excessive air infiltration.
i. Excessive condensation.
j. Glazing to glazing contact.
k. Sealant failures.
l. Framing members transferring stresses to glazing, including those caused by thermal and structural movements.
m. Failure of operating components.

2. Warranty Period: 10 years from date of Substantial Completion.

B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide the following:

1. Kawneer Company, Inc.

a. Type CW-1: Series 1600 Wall System 1.
b. Type CW-2: Series 1600 SS.

2. Or Comparable Equal, subject to compliance with performance requirements herein, and with Section 016000 "Product Requirements."

B. Source Limitations: Obtain all components of curtain wall system, including framing, spandrel panels, and accessories, from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Deferred-Approval Engineering Responsibility: Engage a qualified California-licensed professional engineer, as defined in Section 014000 "Quality Requirements," to engineer glazed aluminum curtain walls and entrances.

B. General Performance: Comply with performance requirements specified, as determined by testing of glazed aluminum curtain walls and entrances representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Glazed aluminum curtain walls and entrances shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads, wind and seismic loads.
2. Glazed aluminum curtain walls and entrances shall accommodate tolerances in construction, including, but not limited to, those from: structural frame tolerances, manufacturing tolerances, and field installation tolerances.
3. Failure also includes the following:

    a. Structural failures including, but not limited to, deflection exceeding specified limits.
    b. Thermal stresses transferring to building structure.
    c. Glass breakage.
    d. Noise or vibration created by wind and thermal and structural movements.
    e. Loosening or weakening of fasteners, attachments, and other components.
    f. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
    g. Water penetration through fixed glazing and framing areas.
    h. Excessive air infiltration.
    i. Excessive condensation.
    j. Glazing to glazing contact.
    k. Sealant failures.
    l. Framing members transferring stresses to glazing, including those caused by thermal and structural movements.

4. Glazed aluminum curtain walls and entrances shall comply with the 2016 CBC and the 2016 CEC.

C. Rainscreen: The curtain wall systems and interface details between the curtain wall systems and adjacent envelope components shall be designed utilizing rainscreen principles.

1. Two distinct lines of protection against water ingress shall be provided, with the interior line of protection providing the primary air barrier of the system.

    a. The air and water seal shall extend from the curtain wall frame to appropriate air and water barrier of the adjacent system.
    b. The exterior weather seal or flashing shall extend from the exterior of the curtain wall system to the exterior cladding or similar water shedding surface of the adjacent construction.

2. Provide weeps to allow drainage to the exterior of water, which enters the space between the interior and exterior seals. Where feasible, provide drainage to the exterior at horizontal mullions below each glazing unit, or at stack joints. Unless otherwise indicated or approved by the Architect, drainage paths shall be concealed or similarly protected from direct exposure to wind-driven rain.

D. Structural Loads:

1. Wind Loads: As indicated on Drawings.

E. Deflection of Framing Members: At design wind pressure, as follows:

1. Deflection Normal to Wall Plane: Limited to the stricter of the following:

   a. Edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite.
   b. 1/175 of clear span for spans up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches.
   c. 1/360 of clear span for spans adjacent to interior gypsum board.
   d. Or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.

2. Deflection Parallel to Glazing Plane: Limited to the stricter of the following:

   a. 1/360 of clear span or 1/8 inch, whichever is smaller.
   b. Amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch.
   c. Operable Units: Provide a minimum 1/16-inch clearance between framing members and operable units.

3. Cantilever Deflection: Where framing members overhang an anchor point, limit deflection to two times the length of cantilevered member, divided by 175.

F. Structural: Test according to ASTM E 330 as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

G. Interstory Drift: Accommodate design displacement of adjacent stories indicated.

1. Elastic and Inelastic Displacements: As indicated on Structural Drawings.
2. Test Performance: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.4 at elastic displacement and inelastic displacement.

H. Seismic Performance: Glazed aluminum curtain walls and entrances shall withstand the effects of earthquake motions determined according to the 2016 CBC.

1. Seismic Drift Causing Glass Fallout: Complying with criteria for passing based on building occupancy type at elastic displacement and inelastic displacement when tested according to AAMA 501.6 or by engineering analysis.

I. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:

1. Fixed Framing and Glass Area:

   a. Maximum air leakage of 0.06 cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft.

2. Commercially Glazed Swinging Entrance Doors:

   a. Maximum air leakage at a static-air-pressure differential of 1.57 lbf/sq. ft. in accordance with CEC Section 110.6 (a) 1.:

      1) Single swinging doors: 0.3 cfm/sq. ft.
      2) Double swinging doors: 1.0 cfm/sq. ft.

J. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 12 lbf/sq. ft.

K. Water Penetration under Dynamic Pressure: Test according to AAMA 501.1 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 12 lbf/sq. ft.
2. Maximum Water Leakage: No uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters, or water that is drained to exterior.

L. Energy Performance: Certify and label energy performance according to NFRC as follows:

1. Thermal Transmittance (U-factor): In compliance with project's "Envelope Mandatory Measures" (ENV-1).
2. Thermal Transmittance of Entrance Doors: In compliance with project's "Envelope Mandatory Measures" (ENV-1).
3. Solar Heat Gain Coefficient: In compliance with project's "Envelope Mandatory Measures" (ENV-1).
4. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC-certified condensation resistance rating of no less than 71 (frame) and 71 (glass) as determined according to AAMA Specification 1503.
5. Continuity of Air Barrier: Provide a complete and uninterrupted air barrier integrated with the other wall barrier systems.
6. Continuity of Vapor Barrier: Provide a complete and uninterrupted vapor barrier integrated with the other vapor barrier systems.

M. Structural-Sealant Joints: Designed to produce tensile or shear stress of less than 20 psi.

N. Structural Sealant: Capable of withstanding tensile and shear stresses imposed by structural-sealant-glazed curtain walls without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant shall occur before adhesive failure.

1. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.
2. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate because sealant-to-substrate bond strength exceeds sealant's internal strength.

O. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.

    a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F.
    b. Low Exterior Ambient-Air Temperature: 10 deg F.
    c. Interior Ambient-Air Temperature: 75 deg F.

P. Insulation Barrier: Design, fabricate and install glazed aluminum curtain wall to work as an integral continuous insulation and air barrier to provide an insulated glazed aluminum curtain wall system.

1. In an effort to achieve the thermal resistance indicated herein and in other Sections as determined by the Energy Modeler/Mechanical Consultant, provide additional insulation thickness to compensate for losses insulation value due to wall supports, configuration, gaps and tolerances between wall panels, and other wall assembly component requirements.

Q. Accessibility Requirements: Comply with applicable provisions in the 2010 ADA Standards for Accessible Design and the accessibility requirements of the 2016 CBC for door hardware on doors in an accessible route.

1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
2. Comply with the following maximum opening-force requirements:

    a. Exterior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.

3. Provide thresholds not more than 1/2 inch high. Changes in level between 1/4 inch high minimum and 1/2 inch high maximum shall be beveled with a slope not steeper than 1:2.
4. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch.
5. Door closers and stops shall not reduce headroom to less than 78 inches.
6. Floor-mounted door stops and other similar obstructions shall be installed 4 inches maximum from the face of the wall or partition. Floor stops shall not be located in the path of travel.
7. Panic hardware shall be mounted between 36 inches and 44 inches above finished floor such that the clear width of the exitway is not less than 32 inches measured between the face of the door and the opposite stop. The unlatching force of panic hardware shall not exceed 5 lbs, applied in the direction of travel.
8. Swinging door surfaces within 10 inches of the finish floor or ground surface measured vertically shall have a smooth surface on the push side extending the full width of the door.

2.3 FRAMING

A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermally broken.
2. Glazing System:

    a. Type CW-1: Retained mechanically with gaskets on four sides.
    b. Type CW-2: Retained mechanically with gaskets on two sides (horizontally) and structural silicone glazed (vertically) on the other two sides.

3. Glazing Plane: Front.
4. Glazing Direction:

    a. Type CW-1: Outside glazed.
    b. Type CW-2: Outside glazed.

5. Finish: High-performance organic finish.
6. Fabrication Method: Field-fabricated stick system.

    a. Type CW-1: Shear block.
    b. Type CW-2: Screw spline.

7. Frame Depth: No less than the following, subject to compliance with performance requirements:

    a. Type CW-1: 6 inches.
    b. Type CW-2: 6 or 7-1/2 inches, as indicated on Drawings, and also subject to compliance with performance requirements.

B. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.

1. Include snap-on aluminum trim that conceals fasteners.
2. See "Sun Control and Mullion Covers" Article below.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

D. Materials:

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

   a. Sheet and Plate: ASTM B 209.
   b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
   c. Extruded Structural Pipe and Tubes: ASTM B 429.
   d. Structural Profiles: ASTM B 308.

2. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.

   a. Structural Shapes, Plates, and Bars: ASTM A 36.
   b. Cold-Rolled Sheet and Strip: ASTM A 1008.
   c. Hot-Rolled Sheet and Strip: ASTM A 1011.

2.4 ENTRANCE DOOR SYSTEMS

A. Basis-of-Design Entrance System: Subject to compliance with requirements, provide the following:

1. Kawneer Company, Inc.; Series 350 Heavy Wall Entrances.

B. Entrance Doors: Manufacturer's heavy duty glazed entrance doors for manual-swing operation.

1. Door Construction: 2-inch overall thickness, with minimum 0.188-inch-thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
2. Door Design:

   a. Rail Sightline: 3-1/2 inch.
   b. Bottom Rail: Provide with 10 inch bottom rail in compliance with the accessibility requirements of the 2016 CBC.

3. Glazing: As indicated on Drawings and as specified in Section 088000 "Glazing."
4. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.

   a. Provide nonremovable glazing stops on outside of door.
   b. Provide optional square glazing stops to accommodate 1-inch insulated glazing as specified in Section 088000 “Glazing.”

5. Finish: High-performance organic finish.

   a. Color: Custom color to match adjacent curtain wall system.

2.5 ENTRANCE DOOR HARDWARE

A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."

2.6 SUN CONTROL AND MULLION COVERS

A. Sunshades: Assemblies consisting of manufacturer's standard outrigger brackets, louvers, and fascia, designed for attachment to curtain wall with mechanical fasteners.

1. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide the following:

a. Kawneer Company, Inc.; “Versoleil Sunshade System:”

2. Vertical Units: “Single Blade System.”

a. Orientation: Vertical.
b. Projection from Wall: As indicated on Drawings.
c. Outriggers: Straight with square edges.
d. Louvers:

1) Number: Single.
2) Shape: As indicated on Drawings.
3) Width: As indicated on Drawings.
4) Mounting Angle: As indicated on Drawings.

3. Finish: Match adjacent glazed aluminum curtain wall.

B. Mullion Caps/Covers: Assemblies consisting of manufacturer's standard optional or custom mullion caps designed for attachment to curtain wall with mechanical fasteners.

1. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide the following:

a. Kawneer Company, Inc.

2. Profile: As indicated on Drawings.
3. Finish: Match adjacent glazed aluminum curtain wall.

C. Materials:

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

a. Sheet and Plate: ASTM B 209.
b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
c. Extruded Structural Pipe and Tubes: ASTM B 429.
d. Structural Profiles: ASTM B 308.

2.7 GLAZING

A. Glazing: Comply with Section 088000 "Glazing."

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

C. Glazing Sealants: As recommended by manufacturer.

1. Sealant shall have a VOC content of 250 g/L or less.

D. Structural Glazing Sealants: ASTM C 1184, chemically curing silicone formulation that is compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant and approved by structural-sealant manufacturer for use in curtain-wall assembly indicated.

1. Color: Black.

E. Weatherseal Sealants: ASTM C 920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and structural-sealant-glazed curtain-wall manufacturers for this use.

1. Color: As indicated on Drawings, or if not indicated, as selected by Architect from manufacturer's full range of sealant colors.

2.8 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.

B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123 or ASTM A 153 requirements.

C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

D. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

2.9 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
6. Provisions for field replacement of glazing:

    a. Type CW-1: From exterior for vision glass and spandrel glazing.
    b. Type CW-2: From exterior for vision glass and spandrel glazing.

7. Unless otherwise required per the performance criteria, mullions and mullion caps shall be continuous, with no breaks or seams.

D. Fabricate components to resist water penetration as follows:

1. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
2. Pressure-equalized system or double barrier design with primary air and vapor barrier at interior side of glazed aluminum curtain wall and secondary seal weeped and vented to exterior.

E. Curtain-Wall Framing: Fabricate components for assembly using manufacturer's standard assembly method.

F. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

1. At exterior doors, provide compression weather stripping at fixed stops.

G. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
2. At exterior doors, provide weather sweeps applied to door bottoms.

H. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

I. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.10 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: 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.

2.11 ALUMINUM FINISHES

A. High-Performance Organic Finish: Three-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: Custom color to match Architect’s sample.
2. Orientation: For components with metallic- or mica-coated finishes, fabricate and install units in a consistent direction to avoid shading differences between adjacent components. Components exhibiting this type of shading difference will be rejected and either reoriented or replaced.

2.12 SOURCE QUALITY CONTROL

A. Structural Sealant: Perform quality-control procedures complying with ASTM C 1401 recommendations including, but not limited to, assembly material qualification procedures, sealant testing, and assembly fabrication reviews and checks.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

3.3 INSTALLATION

A. General:

1. Commence initial installation of curtain wall in presence of manufacturer’s technical representative.
2. Comply with manufacturer's written instructions.
3. Do not install damaged components.
4. Fit joints to produce hairline joints free of burrs and distortion.
5. Rigidly secure nonmovement joints.
6. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
7. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
8. Seal joints watertight unless otherwise indicated.
9. Attachment devices for work exposed to view shall be concealed unless otherwise indicated. Where fasteners are permitted by Architect to be exposed to view, finish to match adjacent surface.
10. Install all aluminum components (mullions, caps, trim, metal panels, etc.) with the same orientation of the fluoropolymer finish to ensure running/directional consistent appearance between adjacent pieces of the same material.

B. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum is in contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 "Joint Sealants" to produce weathertight installation.

D. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

E. Install components plumb and true in alignment with established lines and grades.

F. Install glazing as specified in Section 088000 "Glazing."

1. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

G. Install weatherseal sealant according to Section 079200 "Joint Sealants" and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.

H. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.
3. Aluminum framed entrance doors shall be properly installed such that without closer attached, opening force is 1 lbf or less.

3.4 ERECTION TOLERANCES

A. Erection Tolerances: Install glazed aluminum curtain walls to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
3. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.
4. Alignment:

    a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
    b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
    c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.

3.5 FIELD QUALITY CONTROL (BY OWNER)

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Field and shop welds in compliance with CBC 1705.2.
2. Post-installed concrete anchors in compliance with CBC 1705.3.
3. Exterior cladding in compliance with CBC 1705.12.5.

B. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

D. Glazed aluminum curtain walls and entrances will be considered defective if they do not pass tests and inspections.

3.6 FIELD QUALITY CONTROL (BY CONTRACTOR)

A. Manufacturer's Field Service: Contractor shall engage a manufacturer’s technical representative for technical assistance and guidance for installation of glazed aluminum curtain walls and entrances. At a minimum, arrange for manufacturer’s technical representative to observe installation of glazed aluminum curtain wall and entrances during mock-up, initial installation, at mid-point of the installation, and at completion. Provide additional field observation as required to obtain warranty specified and when requested by Architect or Owner. After each field visit, submit manufacturer’s written report of observations within 3 working days. The report shall note overall quality of work, deficiencies, and any other concerns, and recommend corrective action.

B. Testing Agency: Contractor shall engage a qualified testing agency to perform tests and inspections.

C. Field Quality-Control Testing: Perform the following test on representative areas of glazed aluminum curtain walls.

1. Water Penetration Test (Chamber Test): Before installation of interior finishes has begun, conduct tests in accordance with ASTM E 1105. No uncontrolled water leakage is permitted when tested at a static test pressure of two-thirds the specified water penetration pressure, but not less than 12 psf for fixed glazing and reduced pressure applicable for door performance.

    a. Test Area Locations and Size: As determined by Envelope Consultant.
    b. Frequency:

        1) CW-1: At 10 percent completion.
        2) CW-2: At 10 percent completion.
        3) Entrances: At 10 percent completion.

2. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Envelope Consultant shall be tested according to AAMA 501.2 and shall not evidence water penetration.

    a. Test Area Locations and Size: As determined by Envelope Consultant.
    b. Frequency:

        1) CW-1: At 10, 30, and 70 percent completion.
        2) CW-2: At 10, 30, and 70 percent completion.

3. Structural-Sealant Adhesion: Test structural sealant according to recommendations in ASTM C 1401, Destructive Test Method A, "Hand Pull Tab (Destructive)," Appendix X2.

    a. Test a minimum of six areas on each building façade utilizing curtain wall system CW-2.
    b. Repair installation areas damaged by testing.

4. Reports: Record testing and inspection results and prepare certified reports according to ASTM E 575 format.

D. Deferred Approval Field Inspection: Inspect work, including connection and attachment to building structural frame, for compliance with deferred-approval engineering, and direct deficiencies to be corrected.

1. Certification: Upon resolution of deficiencies, certify work complies with delegated engineering, authorities having jurisdiction, applicable local building codes, specified requirements, and is in keeping with generally accepted engineering practices.
2. Manufacturers Field Inspection: Manufacturers technical representative shall inspect first days' work and periodically inspect work to ensure installation is proceeding in accordance with manufacturer’s designs, recommendations, instructions and warranty requirements. Representative shall submit written reports of each visit indicating observations, findings and conclusions of inspection.

E. Glazed aluminum curtain walls and entrances will be considered defective if they do not pass tests and inspections.

F. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.

G. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

H. Prepare test and inspection reports.

3.7 MAINTENANCE SERVICE

A. Entrance Door Hardware:

1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.
2. Initial Maintenance Service: Beginning at Substantial Completion, provide twelve (12) months' full maintenance by skilled employees of entrance door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Use parts and supplies that are the same as those used in the manufacture and installation of original equipment.

3.8 ADJUSTING

A. Adjust entrance doors and hardware to produce smooth operation and tight fit at contact points.

1. For aluminum-framed entrance doors accessible to people with disabilities:

    a. Adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches from the latch measured to the leading door edge.
    b. Adjust door hardware to comply with the accessibility portion of the “Performance Requirements” Article in Part 2.

3.9 CLEANING AND PROTECTION

A. Protect glazed aluminum curtain walls, entrances, and glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.

B. Protect glazed aluminum curtain walls, entrances, and glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

C. Examine glass surfaces adjacent to exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 084413

SECTION 084426 - POINT-SUPPORTED GLAZING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Point-supported (spider type) glazing assemblies, including, but not limited to, the following components:

a. Spider-type fittings.
b. Perimeter glazing channels.
c. Stainless steel components.
d. Architecturally exposed structural steel support system and anchorage of above components.
e. Glazing.
f. Sealants, caulking, joint fillers and gaskets.
g. Flashings, gutters, weep mechanisms, and closures, shown or as required in conjunction with system or to join systems to adjacent construction.
h. Anchorages provided per this Section and installed under other Section(s).

2. Field testing.

B. Permit Submittal Package: Contractor's responsibilities include providing preconstruction permit submittal package, coordinated with and formatted to match the design team documents, including drawings, calculations, and other analysis data, stamped and signed by the qualified California-licensed professional engineer responsible for their preparation. Contractor's responsibilities also include addressing/ correcting/responding to City of ƷeneThe plan examiners comments.

1. Contract Drawings are Diagrammatic: The details shown are intended as a guide for the aesthetic and interfacing requirements other various components of the exterior wall to and with other work; details are intended to establish basic dimensions of the module and the sight lines, jointing and profiles of members. Contractor is responsible for the design and engineering of the system within these aesthetic parameters. The drawings are not to be construed as engineering design, or adequate to meet the engineering design requirements.

2. Design conditions not included in Contract Drawings shall be developed through the Contractor's shop drawings in compliance with these specifications. Architect shall have the final say as to all matters whether detailed or not on the architectural design details.

C. Related Requirements:

1. Section 033000 “Cast-In-Place Concrete” for embedment of anchorage embeds or clips.
2. Section 051213 "Architecturally Exposed Structural Steel (AESS)" for AESS to the extent not provided as part of this Section.
3. Section 055000 “Metal Fabrications” for steel to the extent not provided as part of this Section.
4. Section 079200 “Joint Sealants” for joint sealants to the extent not specified in this Section.
5. Section 084226 "All-Glass Entrances" for all-glass entrances to be installed within point-supported glazing system.
6. Section 084413 "Glazed Aluminum Curtain Walls and Entrances" for entrances within point-supported glazing systems.
7. Section 088000 "Glazing" for glass to be installed in point-supported glazing systems.

1.3 DEFINITIONS

A. AAMA: Architectural Aluminum Manufacturers Association

1. AAMA 501.2, Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems
2. AAMA 503, Voluntary Specification for Field Testing of Storefronts, Curtain Walls and Sloped Glazing Systems. No pressure reduction allowed. Design pressures as specified herein.
3. AAMA 609 & 610, Voluntary Guide Specification for Cleaning and Maintenance of Painted Aluminum Extrusions and Curtain Wall Panels

B. ASTM: American Society for Testing and Materials

1. ASTM E 331: Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
2. ASTM E 1105: Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference.
3. ASTM A570 / A611, Specifications for Steel and Structural Steel
4. ASTM A743, Specification for Castings, Iron Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.

C. CBC: 2016 California Building Code

D. CEC: 2016 California Energy Code.

E. GANA - Glass Association of North America.

1. GANA (GM) - GANA Glazing Manual.
2. GANA (SM) - FGMA Sealant Manual.

F. Water Penetration:

1. Uncontrolled: Infiltrated water that is not captured, controlled or managed to drain to exterior; water that wets perimeter containment system, wall insulation, or normally exposed interior surfaces.
2. Controlled: Infiltrated water that is captured, controlled or managed by flashings, gutters, and sills to drain to exterior; water that does not wet perimeter containment system, wall insulation, or normally exposed interior surfaces.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Construction Manager, Architect, envelope consultant, inspection agency, installer, manufacturer's technical representative, and other installers whose work interfaces with point-supported glazing systems.
2. Review the following:

a. Contract Document requirements.
b. Reviewed submittals.
c. Installation procedures.
d. Inspection and testing.
e. Forecasted weather conditions and procedures for coping with unfavorable conditions.
f. Tour representative areas of required work, discuss and evaluate for compliance with Contract Documents and approved submittals, including substrate conditions, surface preparations, sequence of installation and other preparatory work performed by other installers.

3. Contractor shall prepare minutes of preinstallation conference and distribute to participants.

1.5 ACTION SUBMITTALS

A. Transmit all action and informational submittal items together in one single complete submittal package for review.

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

C. Sustainable Design Submittals: Product data for sealants, indicating VOC content.

D. Shop Drawings for Preliminary Purposes: Prior to submission of shop drawings, submit plans, elevations, and large-scale details showing an abbreviated overview of products that will subsequently be explained in greater detail in shop drawings. Include preliminary structural calculations.

E. Shop Drawings: Provide project-specific shop drawings for point-supported glazing systems. Include plans, elevations, sections, full-size details, and attachments to other work. Include the following:

1. Descriptions, types, sizes, and profiles of products; including those concealed.
2. Glazing material identification
3. Manufacturers, products, types, sizes, lengths, spacings, embedment, and edge distances of anchors, fasteners, cables, bolts, castings, fittings and attachment devices. Include torque on fastener assemblies.
4. Support framing, reinforcement, and connections to building structure.
5. Types of welded connections using AWS welding symbols.
6. Loose, cast-in, and field-set hardware, inserts, and connections.
7. Manufacturers, products, types, thicknesses, and layers of finishes.
8. Material, thicknesses, profiles, and other details for flashings, gutters, and drainage troughs.
9. Provisions for expansion and contraction, including dimension limits of movement for moving joints.
10. Fabrication, assembly and installation tolerances.
11. Maximum and minimum joint sizes, including sealants and backer rods.
12. Material descriptions, types, sizes, and profiles for isolation between dissimilar surfaces.
13. Isometric details as requested by Architect.
14. Adjacent and adjoining exterior walls and building structural frame, including work by other trades.
15. Shop drawings shall be stamped and signed by the California-licensed professional engineer responsible for their preparation, including analysis data, indicating compliance with performance requirements.

F. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

1. Full-size samples of each fitting, casting, bolt, glazing channel, attachment devices, anchors and fasteners.
2. Finish Samples: For each type of exposed finish required, prepared on 6-inch square Samples of metal of same thickness and material indicated for the Work. Include the following metal types:

a. Aluminum plate.
b. Stainless steel plate.
c. Steel plate.

3. Glass Samples: For each type of glass product; 12 inches square.
4. Joint Sealant and Backers: For each kind of color and joint sealant required, provide Samples with joint sealants representative of actual conditions formed between two 6-inch long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

G. Permit Submittal Package: Contractor's responsibilities include providing preconstruction permit submittal package, coordinated with and formatted to match the design team documents, including drawings, calculations, and other analysis data, stamped and signed by the qualified California-licensed professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer, installer, professional engineer, and field testing agency.

1. Provide statement from manufacturer indicating installer is certified to install specified products.

B. Energy Performance Certificates: For point-supported glazing systems, accessories, and components from manufacturer.

1. Basis for Certification: NFRC-certified energy performance values for each point-supported glazing system. Provide evidence that proposed systems meets “Envelope Mandatory Measures” (ENV-1).

C. Product Test Reports: For point-supported glazing systems, for tests performed by a qualified testing agency.

1. If test reports are not available, system shall be laboratory tested.
2. Proposed deviations without test reports will not be considered.
3. Material products provided by overseas manufacturers shall be domestically tested and approved by local governing bodies. Contractor shall provide evidence of tests and certifications performed.

D. Fastener and Anchor Test Reports: Certified reports of last completed set of mechanical tests for each device.

E. Welding certificates.

F. Field quality-control reports.

G. Sample Warranties: For special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For point-supported glazing systems to include in maintenance manuals.

1. Include glass replacement procedures.

B. Record Shop Drawings: Record actual installation that varies from that shown originally, giving particular attention to concealed components that would be difficult to identify later; comply with Section 017839 "Project Record Documents."

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 20 years’ experience regularly engaged in the production and sales of point-supported glazing systems that have been used for similar applications with successful results, that meets or exceeds performance requirements indicated, and of documenting this performance by inclusion in test reports and calculations. Manufacturer shall have factory-authorized service representatives who are available for consultation, periodic Project-site observations, and on-site assistance.

B. Installer Qualifications: A firm with not less than 10 years’ experience installing point-supported glazing systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

C. Engineering Responsibility: Prepare data for point-supported glazing systems, including Shop Drawings and calculations, based on testing and engineering analysis for manufacturer’s standard units in systems similar to those indicated for the Project and submission of reports of tests performed on manufacturer’s standard assemblies, signed and sealed by the qualified California-licensed professional engineer responsible for their preparation.

D. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.

E. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code - Steel."
2. AWS D1.2, "Structural Welding Code - Aluminum."
3. AWS D1.6, "Structural Welding Code - Stainless Steel."

F. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.
2. Performance characteristics are indicated by criteria subject to verification by one or more methods, including preconstruction testing, field testing, and in-service performance.
3. Point-supported glazing system shall be so designed that defective or damaged glass, panels, and/or other components can be easily dismantled and replaced without causing damage to other parts of the building.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Comply with AAMA CW-10.

1.10 COORDINATION

A. Coordinate point-supported glazing system installation with flashing, trim, parapets, entrances, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

B. Coordinate installation of miscellaneous metal sub-framing, anchorage items, or other items to be embedded in or attached to other construction before starting that Work. Provide locations, setting diagrams, templates, instructions, and directions for installation. Deliver such items to Project site in time for installation.

C. Pre-Installation Field Measurements: Coordinate exact hardware and anchorage locations with other Trade Contractors before permanently attaching to other construction.

D. Post-Installed Field Measurements: Field verify and examine actual installed locations of connection hardware and anchorage items prior to installation of Work provided under this Section. Notify General Contractor and Architect immediately of any discrepancies in writing. Provide letter from point-supported glazing system installer indicating acceptance of connection hardware and anchorage items.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard or customized form in which manufacturer and installer agree to repair or replace components of point-supported glazing system that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, deflection exceeding specified limits.
b. Thermal stresses transferring to building structure.
c. Glass breakage.
d. Noise or vibration created by wind and thermal and structural movements.
e. Loosening or weakening of fasteners, attachments, and other components.
f. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
g. Water penetration through fixed glazing and framing areas.
h. Excessive air infiltration.
i. Excessive condensation.
j. Glazing to glazing contact.
k. Sealant failures.
l. Framing members transferring stresses to glazing, including those caused by thermal and structural movements.
m. Failure to comply with specified performance requirements.

2. Warranty Period: 10 years from date of Substantial Completion.

B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. System Description: The system is comprised of glass panels which are attached to the steel support structure and have drilled holes such that the glass can be mechanically attached using stainless steel fasteners to the support structure. Joints are comprised of uninterrupted wet silicone with an extruded silicone profile inner compression seal. Stainless steel tension rods are used to brace the structure. General arrangement and profiles for the support structure as indicated on the drawings but the Specialty Glazed Structure Contractor shall be responsible for all engineering of the structural support system. All of these elements shall be provided by the Specialty Glazed Structure Contractor as a single source.

B. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide point-supported glazing system by the following:

1. Novum Structures.

C. Source Limitations: Obtain all components of point-supported glazing system, including framing, spider fittings, anchors, fasteners, glazing, and accessories, from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Permit Submittal Package: Engage a qualified California-licensed professional engineer, as defined in Section 014000 "Quality Requirements," to design point-supported glazing systems.

1. Changes to Building Structural Frame Subsequent to Receipt of Permit: If required by point-supported glazing system professional engineer, submit request for changes to building structural frame to Architect. Construction cost associated with changes shall be at no additional cost to Owner.

B. General Performance: Comply with performance requirements specified, as determined by testing of point-supported glazing systems representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Point-supported glazing systems shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads, wind and seismic loads.
2. Point-supported glazing systems shall accommodate tolerances in construction, including, but not limited to, those from: structural frame tolerances, manufacturing tolerances, and field installation tolerances.
3. Failure also includes the following:

a. Structural failures including, but not limited to, deflection exceeding specified limits.
b. Thermal stresses transferring to building structure.
c. Glass breakage.
d. Noise or vibration created by wind and thermal and structural movements.
e. Loosening or weakening of fasteners, attachments, and other components.
f. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
g. Water penetration through fixed glazing and framing areas.
h. Excessive air infiltration.
i. Excessive condensation.
j. Glazing to glazing contact.
k. Sealant failures.
l. Framing members transferring stresses to glazing, including those caused by thermal and structural movements.

4. Point-supported glazing systems shall comply with the 2016 CBC and CEC.

C. Structural Loads:

1. Wind Loads: As indicated on Drawings.

D. Deflection of Framing Members: At design wind pressure, as follows:

1. Deflection Normal to Wall Plane: Limited to the stricter of the following:

a. Edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite.
b. 1/175 of clear span for spans up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches.
c. 1/360 of clear span for spans adjacent to interior gypsum board.
d. Or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.

2. Deflection Parallel to Glazing Plane: Limited to the stricter of the following:

a. 1/360 of clear span or 1/8 inch, whichever is smaller.
b. Amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch.
c. Operable Units: Provide a minimum 1/16-inch clearance between framing members and operable units.

3. Cantilever Deflection: Where framing members overhang an anchor point, limit deflection to two times the length of cantilevered member, divided by 175.
4. Anchor Movement: Withstand not more than 1/8 inch in any direction for combined movement of anchor relative to building structural frame and framing member relative to anchor.

E. Structural: Test according to ASTM E 330 as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

F. Interstory Drift: Accommodate design displacement of adjacent stories indicated.

1. Elastic and Inelastic Displacements: As indicated on Structural Drawings.
2. Test Performance: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.4 at elastic displacement and inelastic displacement.

G. Seismic Performance: Point-supported glazing systems shall withstand the effects of earthquake motions determined according to the 2016 CBC.

1. Seismic Drift Causing Glass Fallout: Complying with criteria for passing based on building occupancy type at elastic displacement and inelastic displacement when tested according to AAMA 501.6 or by engineering analysis.

H. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:

1. Fixed Framing and Glass Area:

a. Maximum air leakage of 0.06 cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft.

I. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 12 lbf/sq. ft.

J. Water Penetration under Dynamic Pressure: Test according to AAMA 501.1 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 12 lbf/sq. ft.
2. Maximum Water Leakage: No uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters, or water that is drained to exterior.

K. Energy Performance: Certify and label energy performance according to NFRC as follows:

1. Thermal Transmittance (U-factor): In compliance with project's "Envelope Mandatory Measures" (ENV-1).
2. Solar Heat Gain Coefficient: In compliance with project's "Envelope Mandatory Measures" (ENV-1).
3. Condensation Resistance: Prevent condensation on the interior face of the system, with the heating and ventilating system in operation and under the following conditions:

    a. Outdoor: Ambient temperature of 29 deg F; 15 miles per hour wind.
    b. Indoor: Ambient temperature of 70-72 deg F; Relative humidity of 50 percent during working hours.
    c. Confirm with Mechanical Engineer.

4. Continuity of Air Barrier: Provide a complete and uninterrupted air barrier integrated with the other wall barrier systems.

L. Structural-Sealant Joints: Designed to produce tensile or shear stress of less than 20 psi.

M. Structural Sealant: Capable of withstanding tensile and shear stresses imposed by structural-sealant-glazed curtain walls without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant shall occur before adhesive failure.

1. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.
2. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate because sealant-to-substrate bond strength exceeds sealant's internal strength.

N. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.

    a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F.
    b. Low Exterior Ambient-Air Temperature: 10 deg F.
    c. Interior Ambient-Air Temperature: 75 deg F.

2.3 MATERIALS

A. Stainless Steel:

1. AISI Types 201 and 202, Plate, Sheet and Strip: ASTM A 666.
2. AISI Type 301, Tempered and Similar: ASTM A 666.
3. AISI Type 304, Annealed: ASTM A 167.
4. AISI Type 304, Tubing: ASTM A 269.
5. AISI Type 304, 316: ASTM A240, ASTM A666
6. AISI Type 430: ASTM A 176.
7. AISI Type 430, Tubing: ASTM A 268.
8. Hot Rolled and Cold Finished Bars: ASTM A 276.
9. Rolled Shapes, Plates and Bars: ASTM A 572.
10. Rolled Sheet and Strip: ASTM A 606.

B. Spider-Type Fittings

1. Material: 300 series type; for exterior applications, 316 Type.
2. Finish: per Architect's schedule.
3. Channels for glass retention: Minimum thickness 1/4 in.
4. The system shall provide for unitized pre-fixing of all items to glass prior to erection.
5. Fittings with tolerance capability for full range of movements as required per this specification and the Structural Engineer.
6. Articulated or axial adjustment mounting fittings will be in accordance with the design criteria and the approved shop drawings.
7. Use elastomer pads in the single point fixings under load (deformation / expansion / contraction) to significantly reduce residual stress peaks in the glass façade.
8. Movement diaphragms of stainless steel and durable flexible discs shall be incorporated in connections to accommodate oversize holes which allow for thermal movement and glass manufacturing tolerances.
9. Stress induced in the glass by these fittings must be compatible with the strength of the glass and the needs of the performance section of this specification.

C. Aluminum:

1. Alloy and temper recommended by manufacturer for type of use and finish indicated and with strength and durability properties required to fulfill delegated engineering and performance requirements, but no less than 22,000 psi ultimate tensile strength. Conform to the following product quality standards:

    a. Extruded Bars, Tubes and Shapes: ASTM B 221, thickness as required by delegated engineering, but not less than 1/8 in at any location for main frame and sash members.
    b. Sheet and Plate: ASTM B 209, thickness as required by delegated engineering, but not less than 3/16 in.

2. Perimeter channels for glass retention:

    a. Match profile on approved shop drawings. Size as required.

3. Channels for glass retention: Minimum thickness 1/4 in
4. Interior covers and trim: Minimum thickness 1/16 inch, with all exposed edges rolled round.

D. Architecturally Exposed Structural Steel: As specified in Section 051213 "Architecturally Exposed Structural Steel" and in compliance with the following:

1. Structural Shapes, Plates, and Bars: ASTM A 36.
2. Cold Rolled Sheet and Strip: ASTM A 1008.
3. Hot Rolled Sheet and Strip: ASTM 1011.
4. Tubing: ASTM A 500
5. Pipe: ASTM A 53.
6. Uncoated, Cold-Rolled Sheet: ASTM A 1008.
7. Uncoated, Hot-Rolled Sheet: ASTM A 1011.
8. Galvanized Sheet: ASTM A 653, G90.

2.4 FASTENERS AND ANCHORS

A. Selection Criteria:

1. Only domestically manufactured anchors and fasteners are acceptable.
2. Grade 8.0 or higher fasteners not acceptable.
3. Grade A fasteners that are zinc plated shall not be used.
4. Diameter, material thicknesses, and lengths as determined by delegated engineering, and as indicated below, sufficient to attach or anchor item to substrate indicated without failure.
5. Include separators and isolators as required to prevent metal corrosion and electrolytic deterioration.
6. Include separators and isolators as required to prevent impeding movement of moving joints.
7. Fasteners in wet or exposed areas of the wall shall be series 300, non-magnetic stainless steel.
8. Finish exposed fasteners to match adjacent stainless steel or aluminum.
9. Use nuts with positive means of preventing disengagement at expansion or moving connections. Stacking of bolts, use of lock washers, or deforming threads are not allowed.
10. Use matched bolts, washers, and nuts at friction connections.
11. Comply with AAMA TIR-A9 Metal Curtain Wall Fasteners

B. Cap Screws/Bolts/Threaded Rods, Nuts, and Washers: Match material and finish when bolts, washers and nuts are used together.

1. Wet Areas – Stainless Steel Product Quality Standards:

a. Bolts: ASTM F 593, Group 2, Alloy 316 / Group 1, Alloy 304 (ASTM F 738M, Property Class A4, Alloy 316 / Class A1, Alloy 304).
b. Washers: ASTM A 240 or ASTM A 480, Type 316 / 304, dimensions and permissible variations according to ASTM F 436 or ASME B18.22.1, Type A, flat; lock washers not acceptable.
c. Nuts: ASTM F 594, Group 2 / 1, Alloy 316 / 304 (ASTM F 836M, Property Class A4, Alloy 316 / Property Class A1, Alloy 304), nylon inserts.

C. Wet Areas - Self-drilling fasteners used in wet areas shall include Elco's Stal-Guard finish.

D. Dry Areas – Coated Carbon Steel Product Quality Standards:

1. Bolts: One of following:

a. SAE J429, Grade 2 or ASTM A 307, Grade A.
b. SAE J429, Grade 5 or ASTM A 449, Type 1.

2. Washers: ASTM F 436, Type 1, flat; spring lock washers not acceptable.
3. Nuts: ASTM A 563, Type 1.

a. Nylock nuts, Unitorque nuts or other locking device with nylon inserts to prevent disengagement at moving connections.

4. Finish: Mechanically deposited ASTM B695 or hot-dip zinc coating ASTM A153. Thickness not less than 0.002 in (2 mils)

E. Post-Installed Expansion Anchors:

1. Product Quality Standards: ACI 318, D.1 and ICC-ES AC193; approved for cracked concrete conditions when used in concrete that is cracked or may become cracked under connected load, as required by Code.
2. Finish: Stainless steel, mechanically deposited ASTM B695 or hot-dip zinc coating ASTM A153. Thickness not less than 0.002 in (2 mils).
3. Property Class A1, Alloy 304, Property Class A1, Alloy 316
4. Acceptable Manufacturers and Products:

a. ITW; Redhead Truebolt Wedge Anchor.
b. Powers; Bull Wedge Anchor.
c. Simpson; Strong-Bolt Wedge Anchor.

5. Not Acceptable: Chemical type anchors for overhead dead load connections.

F. Threaded Concrete Anchors:

1. Condition of Use: Can only be used under shear load.
2. Material and Finish: Carbon steel with corrosion resistant coating with not less than 2000 hours of salt-spray resistance according to ASTM B 117.
3. Basis of Design: Elco Industries, Inc.; Aggre-Gator with Silver Stalgard finish.
4. Not Acceptable: Self-drilling self-threading fasteners, screw in plugs, and powder actuated fasteners are not permitted in concrete.

G. Self-Drilling and Self-Tapping Drill Screws:

1. Product Quality Standard: SAE J429, Grade 5 and ASTM A 449.
2. Material and Finish: Carbon steel with corrosion resistant coating with not less than 2000 hours of salt-spray resistance according to ASTM B 117.
3. Approved Manufacturers and Products (no substitutions accepted):

a. Elco Industries, Inc.; Dril-Flex Structural Fasteners with Silver Stalgard finish; Alumi-Flex 302 S.S. Drill Screw
b. Hilti, Inc.; Kwik-Flex Self-Drilling Fasteners with Kwik-Cote finish.
c. ITWBuildex; Teks Select with Climaseal ACR finish.

2.5 GLAZING

A. Glazing: Comply with Section 088000 "Glazing."

B. Glass shall be in compliance with ASTM C 1048.

C. Edge finish (Exposed): Beveled and polished, unless otherwise indicated.

D. Edge finish (Not exposed): Ground flat with frosted appearance, unless noted otherwise.

E. Edgework, holes and notches in the glass main plates will be completed before any heat tempering or heat strengthening. Edges and cuts shall be accurate, clean, sharp, square, smooth and free of burrs.

F. Glass Replacement Requirements: Glass replacement of same nominal size unit after initial construction, reusing original gaskets and fittings, without cutting of structural or support members or removal of interior finishes.

G. Glass replacement of same nominal size unit after initial construction, reusing original gaskets and fittings, without cutting of structural or support members or removal of interior finishes.

2.6 SEALANTS

A. Sealants, General: As specified in Section 079200 "Joint Sealants."

B. All exterior sealants and interior joinery sealants (glass pockets, end dams and gutters) shall be silicone. All exterior and interior sealants to be compatible.

C. Splice details to be designed using silicone or a combination of silicone and a non-curing, non-hardening, non-skimming butyl.

2.7 ACCESSORIES

A. Brushings: Nylatron Polyamide.

B. Gaskets / Weatherstripping

1. As specified in Section 088000 "Glazing."
2. Dense extruded silicone, neoprene (silicone-compatible if in contact with silicone) or EPDM, in compliance with ASTM C1115, C864 and C509.

C. Flashing: Required within the system or to join the system to adjacent construction, one of following:

1. ASTM A 240 stainless steel, dead-soft, not less than 0.040 in (19 ga) thick.
2. Aluminum Sheet (anodized / painted), not less than 1/16 in thick. Finish to match framing members when exposed.
3. Neoprene sheet is not acceptable for primary gutters.

D. Baffle Material: PVC coated open cell reticulated urethane foam, 30 to 40 ppi

1. Size and length to meet water and air infiltration design requirements.
2. Mechanically restrained and compressed 30% - 50% in their final position.

E. Shim Material:

1. For Structural Connections: 300 series stainless steel or ASTM A 36 or ASTM A 283 hot-dipped galvanized steel

a. Set in a staggered pattern and fillet welded to each other and to the adjacent steel surfaces.
b. Shims in contact with aluminum shall receive protective coatings to separate dissimilar metals.
c. For Dynamic Connections: Molybdenum disulfide filled nylon (Nylatron) lubricated pads or washers

2. For Static, Non-load transfer Connections: Korolath high impact polysterene pads.

   a. Do not use polystyrene in close proximity to field welds.

3. For Non-Structural Connections: U-shape polystyrene
4. Not Acceptable: Fiber shims or wood shims.

F. Lubricated Sliding pads:

1. Extruded lubrication strips shall be Teflon, or 1/16 inch thick Nylatron.

   a. Pads to permit movement, resist wear, positively stay in position and not be subjected to heat damage from welding or cutting.
   b. Open ended slots are not acceptable.

G. Control of Corrosion and Staining:

1. Prevent galvanic, and other forms of corrosion as well as staining by isolating metals from direct contact with incompatible surfaces. Comply with SSPC-SP COM, rust inhibitive enamel or paint, either air dried or baked.
2. Items of carbon steel, unless galvanized or scheduled for other finish, shall be thoroughly cleaned and painted with zinc chromate primer.
3. Materials:

   a. Zinc Chromate Primer: Specification FS TT-P-645, SSPC- SP COM. Minimum dry film thickness of 3 mil for each coat.
   b. Sealant, tape or approved galvanic isolator
   c. Fluoropolymer paint for aluminum in contact with stainless steel

H. Bituminous Paint: SSPC-Paint 12 and ASTM D1187, cold applied asphalt mastic paint formulated for 30 mil thickness for each coat.

2.8 FABRICATION

A. Assembly/Fabrication Methods shall be at the discretion of the Exterior Wall Contractor (subject to acceptance by the Owner, Architect and Exterior Wall Consultant) provided that the visible architectural effect is not changed, the work of other Contractors is not affected, and the performance is not reduced.

B. Follow conclusions and recommendations from Consultants, Delegated Engineering, Manufacturer's written fabrication instructions, Contract Documents and Approved Submittals.

C. General Requirements:

1. Fabricate and finish at shop to maximum extent possible before shipping to Project.
2. Comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details.
3. Fabricate to dimensions, profiles and details indicated.
4. Fabricated free of burrs, pitting, cutting edges, sharp corners, nicks, dents, and scratches.
5. Fabricate components and assemble units to comply with fire and performance requirements specified.
6. Painted surfaces shall be properly prepared. Comply with "FINISHES" Section.
7. Fabricate components to allow for thermal expansion and contraction, and field adjustments.
8. Provide minimum clearances and depth of glazing pockets as recommended by glass manufacturer for thickness and type of glass indicated.
9. Make provisions to drain water entering at joints and perimeter channels.
10. Covers and trim: Minimum thickness 1/16 inch, with all exposed edges rolled round.
11. Weld before finishing components. Welding shall be done with methods recommended by the suppliers of the metals being welded.
12. Welds behind finished surfaces shall be done as to minimize distortion and/or discoloration on the finished side. Telegraphing of welds through a finished surface will not be accepted. Weld splatter and welding oxides on finished surfaces shall be removed by descaling and/or grinding.
13. Welds shall be of adequate strength and durability, with jointing tight, flush, smooth and clean.
14. Design anchorage to accommodate 1 in three-dimensional maximum variation in the building structure.

2.9 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: 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.

2.10 ALUMINUM FINISHES

A. High-Performance Organic Finish: Three-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: Custom color to match Architect’s sample.
2. Orientation: For components with metallic- or mica-coated finishes, fabricate and install units in a consistent direction to avoid shading differences between adjacent components. Components exhibiting this type of shading difference will be rejected and either reoriented or replaced.

2.11 STAINLESS STEEL FINISHES

A. Stainless-Steel Finishes: Remove tool and die marks and stretch lines, or blend into finish. Grind and polish surfaces to produce uniform finish, free of cross scratches. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.

C. Directional Satin Finish: No. 4, unless otherwise indicated.

2.12 HOT-DIP GALVANIZED STEEL FINISHES

A. Iron and Steel Hardware (Fasteners): ASTM A 153, Class C, coating thickness not less than 0.002 inch (2 mils).

B. Fabricated and Unfabricated Assemblies (Shapes, plates, bar and stip): ASTM A 123, coating thickness not less than 0.002 inch (2 mils).

C. Steel components to be galvanized, unless scheduled for other finish.

2.13 SOURCE QUALITY CONTROL

A. Structural Sealant: Perform quality-control procedures complying with ASTM C 1401 recommendations including, but not limited to, assembly material qualification procedures, sealant testing, and assembly fabrication reviews and checks.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify locations of structural supports.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Commencement of installation indicates acceptance of conditions.

3.2 PREPARATION

A. General: Surfaces shall have no conditions which would cause faulty work or failures, or result in potentially defective installation.

B. Isolate and prevent any degree of incompatibility between all sealants used under this section and those sealants used by other trades that may be in direct contact with or adjacent to sealants in this work.

C. Examine a sample installation of the wall which has been prepared and determine and record whether everyone present is in agreement that the proposed installation is acceptable. Accepted control section shall be standard to which other work must confirm.

D. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

E. Paint steel supporting member prior to installation of structural glass curtain wall system components.

3.3 INSTALLATION

A. Installation Quality Standards: In addition to standards specified elsewhere, perform work according to following, unless otherwise specified:

1. Deferred-Approval documents and calculations..
2. Respective manufacturer’s written instructions, specifications, and recommendations.
3. Approved submittals.
4. Contract Documents.
5. AAMA CWG-1.
6. ASTM E 2112.

B. General:

1. Commence initial installation of curtain wall in presence of manufacturer’s technical representative.
2. Comply with manufacturer's written instructions.
3. Do not install damaged components.
4. Fit joints to produce hairline joints free of burrs and distortion.
5. Rigidly secure nonmovement joints.
6. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
7. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
8. Seal joints watertight unless otherwise indicated.
9. Attachment devices for work exposed to view shall be concealed unless otherwise indicated. Where fasteners are permitted by Architect to be exposed to view, finish to match adjacent surface.

C. Point-Supported Assembly Installation:

1. Install structural glass curtain wall plumb, level, true, located and aligned with established column lines and reference levels.
2. Do not cut, trim, weld, or braze in a manner that will damage finishes, decrease strength, cause visual imperfection, or performance failure.
3. Do not field cut or alter building structural framing without written approval from General Contractor.
4. Finish seams, joints and splices on exposed surfaces shall be imperceptible in finished work.
5. Allow for free and noiseless expansion and contraction movement.
6. Prevent galvanic action and other forms of corrosion by isolating metals from direct contact with incompatible surfaces.
7. Match exposed work to produce continuity of line and finish.
8. Minimize distortion and/or discoloration of welds behind finished surfaces. Telegraphing not accepted. Remove weld splatter and welding oxides on finished surfaces by descaling and/or grinding.
9. Assemble components into a complete weathertight system.

D. Structural Glass Wall Installation:

1. Lap and seal flashing splices minimum 6 in. Seal, not weld, end dams and gutter transitions.
2. Install head, sill and perimeter channels. Shim as required for level and plumbness.
3. Set flashings, channels and all penetrating fasteners in full bed of non-skinning sealant. Install end caps and seal joinery.
4. Seal welds in areas intended to retain and channel water.
5. Drain moisture entering joints and glazing spaces; weep holes must not contribute to staining, streaking or marking on the glass, metal framing or trim, or other exterior cladding components.

E. Glazing:

1. Follow GANA Manual Guidelines and Glass Manufacturer's recommendations.
2. Inspect each piece of glass immediately before installation. Do not install glass or component parts that are defective.
3. Clean glazing channel before setting glass with compatible solvents.
4. Set main glass plates and fixings in sequence shown on approved shop drawings. Adjust glass for level and plumb.
5. Set glass on setting blocks; retain setting blocks and edge blocks in position.
6. Check glass to be certain vertical edges are plumb and edge bite is as specified.
7. Secure glass in place as indicated.
8. Provide a minimum nominal glass bite of 1/2 in. Where joint movement will result in variable glass bite, increase nominal bite as required and provide 1/2 in minimum edge clearance or greater.
9. Mechanically join glass mullions/fins to main plate panels with connector fittings to provide stabilization and support.

F. Attachments and Anchors:

1. Attachment of the Structural Glass Wall to the support structure shall occur inboard of the weather line.
2. Welds shall be of adequate strength and durability, with jointing tight, flush, smooth and clean, following methods recommended by the suppliers of the metals being welded. Protect adjacent materials from weld spatter.
3. Aluminum field welding is prohibited.
4. When installing stainless steel components prevent threads from galling.
5. Anchor components securely and permanently in place, shimming and using attachment methods and devices that permit three-dimensional 1 in adjustment for construction tolerances, irregularities, and alignment.
6. Once wall is properly positioned, all connections shall be rigidly fixed by bolting, welding or other positive mechanical means.
7. Secure glass panels to fittings with bolts. Torque bolt to amount specified using calibrated tool. Lock torqued bolt into position to prevent backoff.
8. Reset calibrations regularly to ensure accurate torquing.
9. Install fastener caps for all bolts when required by manufacturer or design.

10. Deforming or mechanically staking fastener threads outside of nuts or welding nuts to washers or threads is not acceptable. Lock washers are not acceptable.
11. Molybdenum-disulfide filled nylon ("nylatron") slip pads or washers shall be used at all thermal or dynamic anchors.
12. Exposed bolt heads shall be oriented as indicated on the approved shop drawings. Where bolt head alignment is specified, the orientation shall be noted for each connection on the installation drawings. Where not noted, the bolt heads in a given connection shall be oriented to one side.

G. Sealant:

1. Cleaning, priming and sealant installation as specified in Section 079100 – Exterior Wall Joint Sealants.
2. After glass has been retained in final position, install seal as indicated by architectural details.
3. Prevent silicone contact with the PVB interlayer. Sealant shall be shown to be compatible with PVB interlayer and shall show no evidence of fluid migration into the laminated layer.
4. Plate to plate joints shall be sealed with silicone sealant. Joint size to be design to accommodate for movement of the structure and specified loads.

3.4 ERECTION TOLERANCES

A. Erection Tolerances: Install point-supported glazing systems to comply with the following maximum tolerances:

1. Variation for Vertical Members: One of following:

   a. Not more than 1/8 in in 26 ft.
   b. Not more than 1/4 in in 52 ft.

2. Variation for Horizontal Members: Not more than 1/8 in in 25 ft in any direction.
3. Offset from Alignment of Members End to End: Not more than 1/32 in.
4. Offset from Alignment Between Adjacent Main Plates: Not more than 1/32 in.
5. Variation in Plane: One of following:

   a. Not more than 1/16 in in 10 ft at any location.
   b. Not more than 1/8 in over entire face or area.

6. Sealant joint width between Mullions and adjacent construction: minimum of 1/4 in. Maximum variation 1/8 in.

3.5 FIELD QUALITY CONTROL (BY OWNER)

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Field and shop welds in compliance with CBC 1705.2.
2. Post-installed concrete anchors in compliance with CBC 1705.3.
3. Exterior cladding in compliance with CBC 1705.12.5.

B. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

D. Point-supported glazing systems will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.6 FIELD QUALITY CONTROL (BY CONTRACTOR)

A. Manufacturer's Field Service: Contractor shall engage a manufacturer's technical representative for technical assistance and guidance for installation of point-supported glazing systems. At a minimum, arrange for manufacturer's technical representative to observe initial installation of point-supported glazing system, at mid-point of the installation, and at completion. Provide additional field observation as required to obtain warranty specified and when requested by Owner, Architect, Envelope Consultant, and/or General Contractor. After each field visit, submit manufacturer's written report of observations within 3 working days. The report shall note overall quality of work, deficiencies, and any other concerns, and recommend corrective action.

B. Testing Agency: Contractor shall engage a qualified testing agency to perform tests and inspections.

C. Field Quality-Control Testing: Perform the following test on representative areas of point-supported glazing systems.

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Envelope Consultant shall be tested according to AAMA 501.2 and shall not evidence water penetration.

    a. Test Area Locations and Size: At locations determined by Envelope Consultant.
    b. Frequency: At 10, 30, and 70 percent completion.

2. Structural-Sealant Adhesion: Test structural sealant according to recommendations in ASTM C 1401, Destructive Test Method A, "Hand Pull Tab (Destructive)," Appendix X2.

    a. Test a minimum of six areas on each building facade.
    b. Repair installation areas damaged by testing.

3. Reports: Record testing and inspection results and prepare certified reports according to ASTM E 575 format.

D. Deferred Approval Field Inspection: Inspect work, including connection and attachment to building structural frame, for compliance with deferred-approval engineering, and direct deficiencies to be corrected.

1. Certification: Upon resolution of deficiencies, certify work complies with delegated engineering, authorities having jurisdiction, applicable local building codes, specified requirements, and is in keeping with generally accepted engineering practices.
2. Manufacturers Field Inspection: Manufacturers technical representative shall inspect first days' work and periodically inspect work to ensure installation is proceeding in accordance with manufacturer's designs, recommendations, instructions and warranty requirements. Representative shall submit written reports of each visit indicating observations, findings and conclusions of inspection.

E. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.

F. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

G. Point-supported glazing systems will be considered defective if they do not pass tests and inspections.

H. Prepare test and inspection reports.

3.7 CLEANING AND PROTECTION

A. Protect point-supported glazing systems and glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.

B. Protect point-supported glazing systems and glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

C. Examine glass surfaces adjacent to exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 084426

SECTION 086200 - TUBULAR UNIT SKYLIGHTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes self-flashing tubular unit skylights with integral curb.

B. Related Sections:

1. Section 075419 "Polyvinyl-Chloride (PVC) Roofing" for coordination of roofing membrane with tubular unit skylights.
2. Section 076000 "Sheet Metal Flashing and Trim" for flashing to the extent not provided as part of this Section.

1.3 PREINSTALLATION MEETING

A. Preinstallation Conference: Conduct at project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of unit skylight indicated.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for unit skylights.

B. Shop Drawings: For unit skylight work.

1. Provide project specific shop drawings, including plans, elevations, sections, details, and connections to supporting structure and other adjoining work.

C. Aluminum Finish Samples: For each type of exposed finish required, in a representative section of each unit skylight in manufacturer's standard size.

D. Glazing Samples: For each color and finish of glazing indicated, 12 inches square and of same thickness indicated for the final Work.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Product Test Reports: Independent testing agency or evaluation service reports verifying compliance with performance requirements.

C. Evaluation Reports: For tubular unit skylights, from ICC-ES.

D. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For unit skylights to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of tubular unit skylights that have been used for similar applications with successful results, that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports, labels, and calculations.

B. Installer Qualifications: A firm with not less than 5 years' experience installing tubular unit skylights similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

1.8 COORDINATION

A. Coordinate unit skylight flashing requirements with roofing system to form a leak-proof, airtight, watertight, and noncorrosive installation.

B. Coordinate sizes and locations of prefabricated curbs with actual unit skylights provided.

C. Provide anchors and inserts to be placed in adjacent construction in proper sequence so as not to delay the Work.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard or customized form in which manufacturer and installer agree to repair or replace components of tubular unit skylights that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Uncontrolled water leakage.
b. Excessive air infiltration.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
d. Yellowing of glazing.
e. Breakage of glazing.
f. Deterioration of seals.

2. Warranty Period: Ten (10) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

1. Solatube International, Inc.; Solatube 330 DS Closed Ceiling.

Or comparable product by one of the following, subject to compliance with requirements herein and with Division 1 Section "Product Requirements:"

2. VELUX America; SunTunnel.
3. Or Comparable Equal.

B. Source Limitations: Obtain unit skylights from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Test Performance Criteria: Provide unit skylights capable of complying with performance requirements indicated, based on testing manufacturer's unit skylights that are representative of those specified.

1. Structural Performance: Provide unit skylights, including glazing and anchorage, capable of withstanding the effects of the following uniform load test:

a. No breakage, permanent damage to fasteners, hardware parts, or damage to making system inoperable or cause excessive permanent deflection of any section when tested at a positive load of 150 psf or negative load of 70 psf.
b. All units shall be tested with a safety factor of three (3) for positive pressure and two (2) for negative pressure, acting normal to plane of roof in accordance with ASTM E 330.

2. Air Infiltration: Provide unit skylights with maximum air leakage through assembly of 0.3 cfm/sq. ft. when tested according to ASTM E 283 at a minimum static-air-pressure difference of 1.57 lbf/sq. ft..
3. Water Penetration: Provide unit skylights that do not evidence water penetration through assembly when tested according to ASTM E 547 with 10.5 psf pressure differential with water rate of 5 gallons/hour/sf.
4. Fire Testing: Unit shall comply with the fire-resistance rating requirements to comply with the 2016 California Building Code (CBC).

B. Surface-Burning Characteristics of Plastic Glazing: Provide plastic glazing sheets identical to those tested for fire-exposure behavior per test method indicated below by a testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

1. Self-Ignition Temperature: 650 deg F or more for plastic sheets in thickness indicated when tested per ASTM D 1929.
2. Smoke-Production Characteristics: Comply with either requirement below:

a. Smoke-Developed Index: 450 or less when tested per ASTM E 84 on plastic sheets in manner indicated for use.
b. Smoke Density: 75 or less when tested per ASTM D 2843 on plastic sheets in thickness indicated for use.

3. Burning Characteristics: Tested per ASTM D 635.

a. Acrylic Glazing: Class CC2, burning rate of 2-1/2 inches per minute or less for nominal thickness of 0.060 inch or thickness indicated for use.
b. Polycarbonate Glazing: Class CC1, burning extent of 1 inch or less for nominal thickness of 0.060 inch or thickness indicated for use.
c. Polycarbonate-Insulating-Panel Glazing: Class CC2, burning rate of 2-1/2 inches per minute or less for nominal thickness of 0.060 inch or thickness indicated for use.

2.3 MATERIALS

A. Aluminum Components:

1. Sheets: ASTM B 209, alloy and temper to suit forming operations and finish requirements but with not less than the strength and durability of alclad Alloy 3005-H25.
2. Extruded Shapes: ASTM B 221, alloy and temper to suit structural and finish requirements but with not less than the strength and durability of Alloy 6063-T52.

B. Fasteners: Same metal as metal being fastened, nonmagnetic stainless steel, or other noncorrosive metal as recommended by manufacturer. Finish exposed fasteners to match material being fastened.

1. Where removal of exterior exposed fasteners might allow access to building, provide nonremovable fastener heads.

2.4 GLAZING

A. Acrylic Glazing: ASTM D 4802, thermoformable, monolithic sheet, category as standard with manufacturer, Finish 1 (smooth or polished), Type UVF (formulated with UV absorber).

1. Outer Dome Glazing: Type DA, 0.143 inch minimum thickness injection molded acrylic classified as CC2 materials; UV inhibited, impact modified acrylic blend.

B. Glazing Gaskets: Manufacturer's standard.

2.5 INSTALLATION MATERIALS

A. Fasteners: Same material as metals being fastened, non-magnetic steel, non-corrosive metal of type recommended by unit skylight manufacturer, or injection molded nylon.

B. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic, nominally free of sulfur and containing no asbestos fibers, formulated for 15-mil dry film thickness per coating.

C. Sealant: Polyurethane or copolymer based elastomeric sealant as provided or recommended by unit skylight manufacturer.

D. Suspension Wire: Steel, annealed, galvanized finish, size and type for application and ceiling system requirement.

E. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.

F. Roofing Cement: ASTM D 4586, asbestos free, designed for trowel application or other adhesive compatible with roofing system.

2.6 UNIT SKYLIGHTS

A. General: Provide factory-assembled unit skylights that include glazing, extruded-aluminum glazing retainers, gaskets, and inner frames and that are capable of withstanding performance requirements indicated.

B. Roof Flashing Base: One piece, seamless, leak-proof flashing functioning as base support for dome and top of tube.

1. Base Material: Sheet steel, corrosion resistant, conforming to ASTM A 653 or ASTM A 463, 0.028 inch thick.
2. Base Style: Type FCM, Curb cap, with inside dimensions of 27 inches by 27 inches to cover prefabricated curb as indicated.
3. Dome Edge Protection Band: Type PB, for fire-rated roofs. Provide galvanized steel, nominal thickness of 0.039 inches.

C. Tube Ring: Attached to tope of base section; 0.090 inch nominal thickness injection molded high impact PVD; to prevent thermal bridging between base flashing and tubing and channel condensation moisture out of tubing.

D. Dome Seal: Adhesive-backed weatherstrip, 0.63 inch tall by 0.28 inch.

E. Reflective Tubes: Aluminum sheet, thickness 0.018 inch.

1. General:

a. Interior Finish: Spectralight Infinity high reflectance specular finish on exposed reflective surface. Specular reflectance for visible spectrum (400 nm to 760 nm) greater than 99 percent. Total solar spectrum reflectance (400 nm to 2500 nm) less than 93 percent.

b. Extension Tube:

1) Provide manufacturer’s standard reflective extension tube.

c. Reflective 90-degree Adjustable Tube:

1) Extension Tube Angle Adapter: Provide manufacturer’s standard adapters for applications requiring bends.

F. Diffuser Assemblies for Tubes Penetrating Ceilings: Provide manufacturer’s standard ceiling mounted box transitioning from round tube to square ceiling assembly, supporting light-transmitting surface at bottom termination of tube, to fit standard suspended ceiling grids.

1. Diffuser: Optiview diffuser, Class A polycarbonate material with a flame spread index not exceeding 25 and a smoke developed index not exceeding 450, when tested in accordance with ASTM E 84.

G. Wire Suspension: Secure unit to structure.

H. Unit Shape and Size: As indicated on Drawings, or if not indicated, circular, 21-inch diameter.

2.7 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.8 ALUMINUM FINISHES

A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with unit skylight installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Coordinate installation of unit skylight with installation of substrates, vapor retarders, roof insulation, roofing membrane, and flashing as required to ensure that each element of the Work performs properly and that combined elements are waterproof and weathertight.

B. Comply with recommendations in AAMA 1607 and with manufacturer's written instructions for installing unit skylights.

C. Install unit skylights level, plumb, and true to line, without distortion.

D. Anchor unit skylights securely to supporting substrates.

E. Where metal surfaces of unit skylights will contact incompatible metal or corrosive substrates, including preservative-treated wood, apply bituminous coating on concealed metal surfaces, or provide other permanent separation recommended in writing by unit skylight manufacturer.

F. Set unit skylight flanges in thick bed of roofing cement to form a seal unless otherwise indicated.

G. Where cap flashing is indicated, install to produce waterproof overlap with roofing or roof flashing. Seal with thick bead of mastic sealant except where overlap is indicated to be left open for ventilation.

3.3 FIELD QUALITY CONTROL

A. After completion of installation and nominal curing of sealant and glazing compounds but before installation of interior finishes, test for water leaks according to AAMA 501.2.

B. Perform test for total area of each unit skylight.

C. Work will be considered defective if it does not pass tests and inspections.

D. Additional testing and inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.4 CLEANING

A. Clean exposed unit skylight surfaces according to manufacturer's written instructions. Touch up damaged metal coatings and finishes.

B. Remove excess sealants, glazing materials, dirt, and other substances.

C. Remove and replace glazing that has been broken, chipped, cracked, abraded, or damaged during construction period.

D. Protect unit skylight surfaces from contact with contaminating substances resulting from construction operations.

E. Unit Skylight Operating System: Clean and lubricate joints and hardware. Adjust for proper operation.

END OF SECTION 086200

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Mechanical door hardware for the following:

a. Swinging doors.
b. Sliding doors.
c. Folding doors.

2. Cylinders for door hardware specified in other Sections.
3. Electrified door hardware.

B. Related Sections:

1. Section 064023 "Interior Architectural Woodwork" for cabinet door hardware provided with cabinets.
2. Section 081113 "Hollow Metal Doors and Frames" for coordination of door hardware with metal doors and frames, and for door silencers provided as part of hollow metal frames.
3. Section 081416 "Flush Wood Doors" for integral intumescent seals provided as part of labeled fire-rated assemblies, and for coordination with flush wood door assemblies.
4. Section 081433 "Stile and Rail Wood Doors" for coordination with stile and rail wood doors.
5. Section 083323 "Overhead Coiling Doors" for door hardware provided as part of overhead coiling door assemblies.
6. Section 084113 "Interior Aluminum-Framed Storefronts" for door hardware provided as part of interior aluminum-framed storefronts.
7. Section 084413 "Glazed Aluminum Curtain Walls and Entrances" for door hardware provided as part of glazed aluminum entrances.
8. Division 28 Section(s) for coordination with:

a. Access control, for access control devices installed at door openings and provided as part of a security system.
b. Intrusion detection systems, for detection devices installed at door openings and provided as part of an intrusion-detection system.
c. Digital, addressable fire-alarm system for connection to building fire alarm system.

1.3 COORDINATION

A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Security: Coordinate installation of door hardware, keying, and access control with electronic door hardware provided by Owner.

D. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Conference participants shall include Installer's Architectural Hardware Consultant and Owner's security consultant.

B. Keying Conference: Conduct conference at Project site.

1. Conference participants shall include Installer's Architectural Hardware Consultant and Owner's security consultant.
2. Incorporate conference decisions into keying schedule after reviewing door hardware keying system including, but not limited to, the following:

a. Flow of traffic and degree of security required.
b. Preliminary key system schematic diagram.
c. Requirements for key control system.
d. Requirements for access control.
e. Address for delivery of keys.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Details of electrified door hardware.

C. Samples for Verification: For exposed door hardware of each type required, in each finish specified, prepared on Samples of size indicated below. Tag Samples with full description for coordination with the door hardware schedule. Submit Samples before, or concurrent with, submission of door hardware schedule.

1. One sample of lever and rose/escutcheon design, (pair).
2. One sample of closer, including custom finish.
3. Three samples of metal finishes, in minimum 2-by-4-inch samples for sheet and 4-inch long samples for other products.

D. Door Hardware Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant. Coordinate door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Submittal Sequence: Submit door hardware schedule after or concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
2. Format: Use same scheduling sequence and format and use same door numbers as in door hardware schedule in the Contract Documents.
3. Content: Include the following information:

a. Identification number, location, hand, fire rating, size, and material of each door and frame.
b. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
c. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
d. Description of electrified door hardware sequences of operation and interfaces with other building control systems.
e. Fastenings and other installation information.
f. Explanation of abbreviations, symbols, and designations contained in door hardware schedule.
g. Mounting locations for door hardware.
h. List of related door devices specified in other Sections for each door and frame.

E. Keying Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.

C. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency.

D. Warranty: Special warranty specified in this Section.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of door hardware to include in maintenance manuals.

B. Schedules: Final door hardware and keying schedule.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Architect, and Owner about door hardware and keying.

1. Warehousing Facilities: In Project's vicinity.
2. Scheduling Responsibility: Preparation of door hardware and keying schedule.
3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as an Architectural Hardware Consultant (AHC).

1.9 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard or customized form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including excessive deflection, cracking, or breakage.
b. Faulty operation of doors and door hardware.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Four years from date of Substantial Completion, unless otherwise indicated.

a. Exit Devices: 5 years from date of Substantial Completion.
b. Manual Closers: 10 years from date of Substantial Completion.
c. Concealed Floor Closers: 10 years from date of Substantial Completion.

1.11 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

B. Maintenance Service: Beginning at Substantial Completion, provide six months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door and door hardware operation. Provide parts and supplies that are the same as those used in the manufacture and installation of original products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware rated for use in assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C, unless otherwise indicated.

B. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meet requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.

1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. at the tested pressure differential of 0.3-inch wg of water.

C. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

D. Fire Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

E. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the DOJ's "2010 ADA Standards for Accessible Design" and the accessibility requirements of the 2016 California Building Code.

1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
2. Comply with the following maximum opening-force requirements:

    a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
    b. Exterior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
    c. Sliding or Folding Doors: 5 lbf applied parallel to door at latch.
    d. Fire Doors: Minimum opening force allowable by authorities having jurisdiction, not to exceed 15 lbf.

3. Provide thresholds not more than 1/2 inch high. Changes in level between 1/4 inch high minimum and 1/2 inch high maximum shall be beveled with a slope not steeper than 1:2.
4. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch.
5. Door closers and stops shall not reduce headroom to less than 78 inches.
6. Floor-mounted door stops and similar obstructions shall be installed 4 inches maximum from the face of the wall or partition. Floor stops shall not be located in the path of travel.
7. Handles, pulls, latches, locks, and other operable parts on doors shall be 34 inches minimum and 44 inches maximum above finish floor or ground.
8. The lever of lever actuated latches or locks shall be curved with a return to within 1/2 inch of the door to prevent catching on the clothing of persons during egress.
9. Panic hardware shall be mounted between 36 inches and 44 inches above finished floor, such that the clear width of the exitway is not less than 32 inches measured between the face of the door and the opposite stop. The unlatching force of panic hardware shall not exceed 5 lbf applied in the direction of travel.

2.2 SCHEDULED DOOR HARDWARE

A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article to comply with requirements in this Section.

1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products.
2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.

B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by using door hardware designations, as follows:

1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Schedule" Article.

2.3 MANUFACTURER

A. Source Limitations: Obtain each type of door hardware from single manufacturer.

1. Provide electrified door hardware from same manufacturer as mechanical door hardware unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

B. Subject to compliance with requirements, provide door hardware from the following:

Item:	Manufacturer:
Hinges	Stanley
Continuous Hinge	Stanley
Locksets	Best
Cylinders	Best
Exit Devices	Precision
Closers	Stanley
Door Stops	Trimco
Flush Bolts	Trimco
Flat Goods	Trimco
Threshold & Gasketing	National Guard Products

2.4 MATERIALS

A. Fasteners:

1. Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated. Provide surface-concealed fasteners where additional overlapping hardware is required.
2. Combination machine screws and expansion shields shall be used for attaching hardware to concrete or masonry
3. Fasteners exposed to the weather or corrosive environments in the finished work shall be completely non-ferrous.

B. Hinges:

1. Template screw hole locations
2. Minimum of 2 permanently lubricated non-detachable bearings
3. Equip with easily seated, non-rising pins
4. Sufficient size to allow 180-degree swing of door

5. Furnish hinges with five knuckles and flush concealed bearings
6. Provide hinge type as listed in schedule.
7. Furnish 3 hinges per leaf to 7 foot 6 inch height. Add one for each additional 30 inches in height or fraction thereof.
8. Tested and approved by BHMA for all applicable ANSI Standards for type, size, function and finish
9. UL10C listed for Fire
10. Provide electric hinge wires with junction box (JB-2R series) to protect wires from mortar filled frames as required.

C. Geared Continuous Hinges:

1. Tested and approved by BHMA for ANSI A156.26-1996 Grade 1
2. Anti-spinning through fastener
3. UL10C listed for 3 hour Fire rating
4. Non-handed
5. Lifetime warranty
6. Provide Fire Pins for 3-hour fire ratings
7. Sufficient size to permit door to swing 180 degrees

D. Mortise Type Locks and Latches:

1. Tested and approved by BHMA for ANSI A156.13, Series 1000, Operational Grade 1, Extra-Heavy Duty, Security Grade 2 and be UL10C
2. Fit ANSI A115.1 door preparation
3. Functions and design as indicated in the hardware groups
4. Solid, one-piece, 3/4-inch (19mm) throw, anti-friction latchbolt made of self-lubricating stainless steel
5. Deadbolt functions shall have 1 inch (25mm) throw bolt made of hardened stainless steel
6. Latchbolt and Deadbolt are to extend into the case a minimum of 3/8 inch (9.5mm) when fully extended
7. Auxiliary deadlatch to be made of one piece stainless steel, permanently lubricated
8. Provide curved-lip strike with dust box for each latch or lock bolt, with lip extended to protect frame, finished to match door hardware set, unless otherwise indicated.
9. Lever handles must be of forged or cast brass, bronze or stainless steel construction and conform to ANSI A117.1. Levers that contain a hollow cavity are not acceptable
10. Lock shall have self-aligning, thru-bolted trim
11. Levers to operate a roller bearing spindle hub mechanism
12. Mortise cylinders of lock shall have a concealed internal setscrew for securing the cylinder to the lockset. The internal setscrew will be accessible only by removing the core, with the control key, from the cylinder body.
13. Spindle to be designed to prevent forced entry from attacking of lever
14. Provide locksets with 7-pin removable and interchangeable core cylinders
15. Each lever to have independent spring mechanism controlling it
16. Core face must be the same finish as the lockset

E. Exit Devices shall:

1. Tested and approved by BHMA for ANSI 156.3, Grade 1
2. Provide 9001-Quality Management and 14001-Environmental Management.
3. Furnish UL or recognized independent laboratory certified mechanical operational testing to 9 million cycles minimum.
4. Provide a deadlocking latchbolt
5. Non-fire rated exit devices shall have cylinder dogging.
6. Touchpad shall be “T” style with beveled end caps - no overhang to catch clothing
7. Exposed components shall be of true architectural metals and finishes.
8. Lever design shall match lockset lever design
9. Provide strikes as required by application.
10. Fire exit devices to be listed for UL10C
11. UL listed for Accident Hazard
12. Shall consist of a cross bar or push pad, the actuating portion of which extends across, shall not be less than one half the width of the door leaf.
13. Provide vandal resistant or breakaway trim
14. Sex bolts only at fire doors unless specified for non-rated doors.
15. Full cover end caps with robust end cap mounting bracket

F. Cylinders:

1. Provide cylinder housings, collars, rings & springs as recommended by the manufacturer for proper installation.
2. Provide cylinder cams or tail piece as required to operate all locksets and other keyed hardware items listed in the hardware sets.
3. Provide cylinder guards for all exposed cylinders at exterior perimeter doors.
4. Coordinate and provide as required for related sections.

G. Door Closers shall:

1. Tested and approved by BHMA for ANSI 156.4, Grade 1
2. UL10C certified
3. Closer shall have extra-duty arms and knuckles where required
4. Conform to ANSI 117.1
5. Maximum 2 7/16 inch case projection with non-ferrous cover
6. Separate adjusting valves for closing and latching speed, and backcheck
7. Provide adapter plates, shim spacers and blade stop spacers as required by frame and door conditions
8. Full rack and pinion type closer with 1½“ minimum bore
9. Mount closers on non-public side of door, unless otherwise noted in specification
10. Closers shall be non-handed, non-sized and multi-sized 1 through 6
11. Provide BF or barrier free at non rated doors as required per code

H. Electronic Hold-Open Closers:

1. Integrate with UL listed fire/life safety alarm systems
2. UL Listed for smoke barrier or labeled fire doors
3. UL Listed for self-closing doors without hold-open
4. ANSI 156.15
5. Field adjustable degree of hold-open
6. Non-handed
7. Safe manual engagement/disengagement
8. Convenient system check switch
9. Field adjustable hold-open force
10. Up to 150 degrees hold open pull side mount
11. Up to 129 degrees hold open push side mount

G. Overhead Stops: Non-ferrous base material. Non-plastic mechanisms and finished metal end caps. Field-changeable hold-open, friction and stop-only functions.

H. Auxiliary Power Supply: Specifically designed to support electric locks and access controls.

1. 115VAC input
2. Fire Alarm/Life Safety emergency release included in power supply.
3. Multiple door options four or more control stations, Adjustable Time delay relay,
4. Filtered and regulated
5. Field selectable 12VDC or 24VDC output
6. Provide as specified unless provided by access control provider.

I. Door Stops:

1. Wall stop and floor stop shall be wrought bronze, brass or stainless steel.
2. Provide fastener suitable for wall construction.
3. Coordinate reinforcement of walls where wall stop is specified.
4. Provide dome stops where wall stops are not practical. Provide spacers or carpet riser for floor conditions encountered

J. Flush Bolts:

1. Automatic flush bolts shall meet ANSI/BHMA A156.3
2. Manual flush bolts shall meet BHMA A156.16 requirements.
3. Bottom bolt shall have 12 inch (305 mm) long operating rod. Top bolt operating rod shall be determined by door height, assuring the operator is located less than 72 inches (183 cm) above the floor.
4. Manual Flush Bolts are not to be utilized except where a pair of non-rated doors serving a room not normally occupied is needed for the movement of equipment.
5. Provide dust proof strikes for bottom bolts. Dust proof strikes shall meet BHMA A156.16.

K. Coordinator and Brackets:

1. Coordinator shall comply with ANSI/BHMA A1156.3 Type 21A full width of the opening.
2. Provide mounting brackets for soffit applied hardware.
3. Provide hardware preparation (cutouts) for latches as necessary.

L. Push Plates: Provide with four beveled edges, .050 thickness, size as indicated in hardware set. Furnish oval-head countersunk screws to match finish.

M. Pulls with plates: Provide with four beveled edges, .050 thickness Plate s with ANSI J401 Pull as listed in hardware set. Provide proper fasteners for door construction.

N. Kick Plates: Provide with four beveled edges ANSI J102, 12 inches high by width less 2 inches on single doors and 1 inch on pairs of doors. Furnish oval-head countersunk screws to match finish.

O. Mop Plates: Provide with four beveled edges ANSI J103, 6 inches high by width less 1 inch on single doors and 1 inch on pairs of doors. Furnish oval-head countersunk screws to match finish.

P. Armor Plates: Provide ANSI J101 with four beveled edges, 34 inches high by width less 1 inch on single or pairs of doors. Furnish oval-head countersunk screws to match finish.

1. Provide cutouts for hardware as listed in the hardware sets.
2. Provide Warnock Hersey labeled plates for 3 hour metal fire doors where allowed by local authority.

Q. Seals: All seals shall be finished to match adjacent frame color. Seals shall be furnished as listed in schedule. Material shall be UL listed for labeled openings.

R. Door Bottoms: Surface mounted or concealed door bottom where listed in the hardware sets.

1. Door seal shall be resilient seal of (Neoprene, Polyurethane, Nylon Brush, Silicone)
2. UL10C Positive Pressure rated seal set when required.
3. Coordinate door bottom with threshold height and door undercut such that door bottom provides accurate seal with threshold without binding door or preventing positive latching.
4. Notch as required for adjacent hardware.

S. Thresholds: Thresholds shall be aluminum or bronze type for conformance with ADA requirements. Furnish as specified and/or per details. Provide fasteners and screws suitable for floor conditions.

1. Refer to Door Schedule and Drawing details for type and configuration required. Additionally, where combustible flooring passes under doors, provide fire door thresholds in accordance with applicable regulatory requirements.
2. Saddle, offset, and bumper seal type thresholds as required for applications.

T. Silencers: Furnish silencers on all interior frames, 3 for single doors, 2 for pairs. Omit where any type of seals occur.

U. Knox Co, 3200 Series: Subject to compliance with requirements provide as required.

1. Recessed mount, UL-listed, heavy-duty unit; fabricate from 1/4-inch-thick steel plate.
2. Provide with restricted keying as required by Local Fire Department.
3. Provide one box at each main entry from each parking area designated with a fire emergency lane.
4. Provide tamper alarm switch with each box.
5. Provide outlet boxes, conduit, wiring, and connections as specified in appropriate Division 25-28 Sections.
6. Coordinate finish as required with Architect

V. Junction Box:

1. Coordinate and provide as required by Electrical Contractor.
2. All electrical components to be wired to junction box and labeled.
3. Coordinate with Related Trades

W. Door Monitoring:

1. Door Position Switch: Coordinate with access control provider as required.

   a. At all fired rated door and frames the [concealed] position switch preparation will be provided by the door and frame manufacturer or by an authorized label service agent.

2. Request to Exit: Coordinate with access control provider as required.
3. Latchbolt Monitoring: Coordinate with access control provider as required.

2.5 KEYS AND KEYING

A. Provide keyed brass construction cores and keys during the construction period. Construction control and operating keys and core shall not be part of the Owner's permanent keying system or furnished in the same keyway (or key section) as the Owner's permanent keying system. Permanent cores and keys (prepared according to the accepted keying schedule) will be furnished to the Owner.

B. Cylinders, interchangeable core master keyed system: BEST [Patented] Cormax

C. Permanent keys and cores: Stamped with the applicable key mark for identification. These visual key control marks or codes will not include the actual key cuts. Permanent keys will also be stamped "Do Not Duplicate."

D. Transmit Grand Masterkeys, Masterkeys and other Security keys to Owner by Registered Mail, return receipt requested.

E. For estimate furnish keys in the following quantities:

1. 1 each Grand Masterkeys
2. 4 each Masterkeys
3. 2 each Change keys each keyed core
4. 15 each Construction masterkeys
5. 1 each Control keys
6. 100 each Key Blanks

F. Bitting List: use secured shipment direct from point of origination to Owner upon completion.

G. The Owner, or the Owner's agent, will install permanent cores and return the construction cores to the Hardware Supplier. Construction cores and keys remain the property of the Hardware Supplier.

H. Keying Schedule: Arrange for a keying meeting and programming meeting with Architect Owner and hardware supplier, and other involved parties to ensure locksets and locking hardware are functionally correct and keying and programming complies with project requirements. Furnish 3 typed copies of keying and programming schedule to Architect.

2.6 FABRICATION

A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Architect.

1. Manufacturer's identification is permitted on rim of lock cylinders only.

B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.

C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
2. Fire-Rated Applications:

a. Wood or Machine Screws: For the following:

1) Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors and frames.
2) Strike plates to frames.
3) Closers to doors and frames.

b. Steel Through Bolts: For the following unless door blocking is provided:

1) Surface hinges to doors.
2) Closers to doors and frames.
3) Surface-mounted exit devices.

3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
4. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."

2.7 FINISHES

A. Designations used in Schedule of Finish Hardware - 3.5, and elsewhere to indicate hardware finishes are those listed in ANSI/BHMA A156.18 including coordination with traditional U.S. finishes shown by certain manufacturers for their products

B. Powder coat door closers to match other hardware, unless otherwise noted.

C. Aluminum items shall be finished to match predominant adjacent material. Seals to coordinate with frame color.

D. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

E. 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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.

B. Wood Doors: Comply with DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Wood Flush Doors."

3.3 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8
2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
3. Accessibility Standards: Conform to the 2010 ADA Standards for Accessible Design and the accessibility requirements of the 2016 California Building Code for positioning requirements for disabled.

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

C. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

D. Lock Cylinders: Install construction cores to secure building and areas during construction period.

1. Replace construction cores with permanent cores as directed by Owner.
2. Furnish permanent cores to Owner for installation.

E. Closers: Coordinate installation of closer for maximum degree of hold open or opening. Hold open arms to stop door from hitting wall. Closers typically mount on interior side of room.

F. Locksets: Provide appropriate backset to center lockset on stile and rail type doors.

G. Thresholds: Set thresholds for exterior doors in full bed of sealant complying with requirements specified in Division 7 Section “Joint Sealants.” Securely and permanently anchor exterior thresholds using countersunk non-ferrous screws to match color of threshold. Stainless steel screws at aluminum thresholds. Set thresholds at interior acoustical rated openings with acoustical sealant.

H. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, verify location with Architect.

I. Mount cylinder keyways in proper position as recommended by manufacturers

J. Gaskets: install jamb-applied gaskets before closers, overhead stops, rim strikes, etc; fasten hardware over and through these seals where possible. Install sweeps across bottoms of doors before astragals, cope sweeps around bottom pivots, trim astragals to tops of sweeps.

K. Replace fasteners damaged by power-driven tools.

L. Silencers: Set in place before adjusting strikes.

M. Raindrips: Set in waterproof sealant and fasten as recommended by manufacturer.

N. Floor Stops: Floor stops shall be installed a maximum of 4 inches from adjacent walls.

O. Auto Door Bottom shall not be adjusted until substantial completion. Door bottoms are to be raised to highest position while construction occurs (so to not have rubber seal torn or damaged by debris under the door). At substantial completion, adjust door bottom to fully engage and touch the floor for proper sound dampening.

P. Hardware Installer shall coordinate with Security contractor to route cable to connect electrified locks, panic hardware, and fire exit hardware to power transfers or electric hinges at the time these items are installed so as to avoid disassembly and reinstallation of hardware.

Q. Hardware Installer shall also be present with the security contactor when the power is turned on for the testing of the electronic hardware applications. Installer shall make adjustments to solenoids, latches, vertical rods and closer to insure proper and secure operation

R. All wiring for electro-mechanical hardware mounted on the door shall be connected through the power transfer and terminated in the interface junction box.

S. Conductors shall be minimum 18 gage stranded multicolored unless specified otherwise. A minimum 12 inch loop for conductors shall be coiled in the interface junction box. Each conductor shall be permanently marked with its function.

T. If a power supply is specified in the hardware sets, all conductors shall be terminated in the power supply. Make all connections required for proper operation between the power supply and the electro-mechanical hardware. Provide the proper size conductors as specified in the manufacture’s technical documentation.

3.4 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
2. Door Closers:

    a. Sweep Period: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
    b. Opening Force: Set door opening force to comply with requirements in “Quality Assurance” Article above.

3.5 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Section 017900 "Demonstration and Training."

3.7 DOOR HARDWARE SCHEDULE

A. See door schedule in drawings for hardware set assignments.

B. The hardware set represent the design intent and direction of the Owner and Architect. They shall not be considered a detailed hardware schedule. Omitted items not included in a hardware set shall be scheduled with the appropriate additional hardware required for proper application and functionality.

C. Manufacturer's Abbreviations:

1. BE BEST
2. NA National Guard Products
3. PE Pemko
4. PR Precision
5. TR Trimco
6. ST Stanley
7. DJ Don Jo
8. AB ABH Manufacturing
9. SD Stanley Door Closers
10. ZE Zero

D. Hardware Sets:

SET #001

2	Continuous Hinge	661 CE-58 x Sch Opt	AL	ST
1	Exit Device	TS 2601 10'0" LD	630	PR
1	Exit Device	MLR TS 2603 10'0"	630	PR
1	Rim Cylinder	12E-72 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
2	Offset Pull	1191-4	630	TR
2	Door Closer	CLD-4551 TJ x P45-180	689	SD
2	Door Stop	1475	626	DJ
1	Weatherstrip	By Alum. Storefront Mfg.		
1	Bumper Seal Threshold	896S	AL	NA
1	Power Supply	RPSMLR2		PR
2	Door Contacts	By Access Control Supplier		
1	Card Reader	By Access Control Supplier		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to temporarily retract active door latch for authorized access.

NOTE: Integrate door monitoring into security system as required.

SET #002

3	Hinges	CB199 4 1/2 X 4 1/2 NRP	US26D	ST
1	Electric Hinge	CE CB199 4 1/2 X 4 1/2 NRP 18	US26D	ST
1	Exit Device	LS MLR TS 2103 X 1703A S301	630	PR
1	Rim Cylinder	12E-72 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Door Closer	CLD-4550 EDA	689	SD
1	Door Stop	1475	626	DJ
1	Gasketing	5050 @ Head & Jambs		NA
1	Door Bottom	600A		NA
1	Threshold	Per Detail	AL	NA
1	Drip Cap	16 A - 4" ODW (as required)		NA
1	Power Supply	RPSMLR2		PR
1	Door Contacts	By Access Control Supplier		
1	Card Reader	By Access Control Supplier		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to retract latch for authorized access. Integrate door monitoring into security system as required.

SET #003

1	Continuous Hinge	661 CE-58 x Sch Opt	AL	ST
1	Exit Device	MLR TS 2403	630	PR
1	Rim Cylinder	12E-72 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Offset Pull	1191-4	630	TR
1	Door Closer	CLD-4551 TJ x P45-180	689	SD
1	Door Stop	1475	626	DJ
1	Weatherstrip	By Alum. Storefront Mfg.		
1	Door Bottom	600A		NA
1	Threshold	Per Detail	AL	NA
1	Power Supply	RPSMLR2		PR
1	Door Contacts	By Access Control Supplier		
1	Card Reader	By Access Control Supplier		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to retract latch for authorized access. Integrate door monitoring into security system as required.

SET #004

3	Hinges	CB199 4 1/2 X 4 1/2 NRP	US26D	ST
1	Electric Hinge	CE CB199 4 1/2 X 4 1/2 NRP 18	US26D	ST
1	Electro-mech Lock	45HW-7DEU15H L/C IDH	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Door Closer	CLD-4550 HCS	689	SD
1	Kick Plate	KO050 12" x 2" LDW x CSK B4E	630	TR
1	Door Bottom	600A		NA
1	Threshold	Per Detail	AL	NA
1	Drip Cap	16 A - 4" ODW (as required)		NA
1	Card Reader	By Access Control Supplier		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to release lever for authorized access. Integrate door monitoring into security system as required.

SET #005

3	Hinges	CB199 5 X 4 1/2 NRP	US32D	ST
1	Electric Hinge	CE CB199 5 X 4 1/2 18	US32D	ST
1	Exit Device	LS MLR TS 2103 X 1703A S301	630	PR
1	Cormax Core	1CDX Series	626	BE
1	Rim Cylinder	12E-72 L/C	626	BE
1	Door Closer	CLD-4550 EDA	689	SD
1	Door Stop	1475	626	DJ
1	Gasketing	5050 @ Head & Jambs		NA
1	Door Bottom	600A		NA
1	Saddle Threshold	Per Detail	AL	NA
1	Drip Cap	16 A - 4" ODW (as required)		NA
1	Power Supply	RPSMLR2		PR
1	Door Contacts	By Access Control Supplier		
1	Card Reader	By Access Control Supplier		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to temporarily retract latch for authorized access. Integrate door monitoring into security system as required.

SET #006

3	Hinges	CB199 4 1/2 X 4 1/2 NRP	US26D	ST
1	Electric Hinge	CE CB199 4 1/2 X 4 1/2 NRP 18	US26D	ST
1	Electro-mech Lock	45HW-7DEU15H L/C IDH	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Door Closer	CLD-4550 HCS	689	SD
1	Gasketing	5050 @ Head & Jambs		NA
1	Door Bottom	600A		NA
1	Saddle Threshold	Per Detail	AL	NA
1	Drip Cap	16 A - 4" ODW (as required)		NA
1	Door Contacts	By Access Control Supplier		
1	Card Reader	By Access Control Supplier		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to temporarily release lever for authorized access. Integrate door monitoring into security system as required.

SET #007

2	Continuous Hinge	661 CE-58 x Sch Opt	AL	ST
1	Exit Device	TS 2601 EXT LBR LD	630	PR
1	Exit Device	MLR TS 2603 EXT LBR	630	PR
1	Rim Cylinder	12E-72 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
2	Offset Pull	1191-4	630	TR
2	Overhead Stop	1020 SL Series	US32D	AB
2	Door Closer	CLD-4551 TJ x P45-180	689	SD
1	Weatherstrip	By Alum. Storefront Mfg.		
1	Gasketing Set	Per Detail		
1	Bumper Seal Threshold	896S	AL	NA
1	Power Supply	RPSMLR2		PR
2	Door Contacts	By Access Control Supplier		
1	Card Reader	By Access Control Supplier		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to temporarily retract active door latch for authorized access.

NOTE: Integrate door monitoring into security system as required.

SET #008

4	Hinges	CB199 4 1/2 X 4 1/2 NRP	US32D	ST
1	Exit Device	FL 2101 LD S301	630	PR
1	Door Closer	CLD-4550 PA	689	SD
1	Door Stop	1475	626	DJ
1	Gasketing	5050 @ Head & Jambs		NA
1	Door Sweep	C627 A		NA
1	Threshold	Per Detail	AL	NA
1	Drip Cap	16 A - 4" ODW (as required)		NA

SET #009

2	Continuous Hinge	661 CE-58 x Sch Opt	AL	ST
2	Exit Device	MLR TS 2603 10'0"	630	PR
1	Cormax Core	1CDX Series	626	BE
1	Rim Cylinder	12E-72 L/C	626	BE
2	Offset Pull	1191-4	630	TR
2	Pneumatic Operator	4820	689	LC
1	Control Box	7902		LC
1	Blow Open Box	ES7949		LC
1	Compressor	921 (50’ maximum distance from door)		LC
1	Tubing	925 (as required)		LC
2	Door Position Switch Kit	4820-3377		LC
2	Push Plate Actuator	8318-856T x 8310-868F (verify flush or surface)		LC
2	Weather Trim Ring	8310-800		LC
2	Overhead Stop	1020 SL Series	US32D	AB
1	Weatherstrip	By Alum. Storefront Mfg.		
1	Bumper Seal Threshold	896S	AL	NA
1	Power Supply	RPSMLR2		PR
2	Door Contacts	By Access Control Supplier		
1	Card Reader	By Access Control Supplier		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to temporarily retract latches for authorized access - TS switch to enable exterior actuator when triggered by latch retraction for power operation as required. Interior actuator always active.

NOTE: Integrate separate Blow Open system into fire alarm. Compressor tank to be 50’ maximum distance from opening.

NOTE: Integrate door monitoring into security system as required.

SET #010

6	Hinges	CB199 4 1/2 X 4 1/2 NRP	US32D	ST
2	Electric Hinge	CE CB199 5 X 4 1/2 18	US32D	ST
1	Removable Mullion	FLKR822	689	PR
1	Exit Device	FL LS TS 2101 S301	630	PR
1	Exit Device	FL LS MLR TS 2103 X 1703A S301	630	PR
2	Rim Cylinder	12E-72 L/C	626	BE
2	Cormax Core	1CDX Series	626	BE
2	Door Closer	CLD-4550 HCS	689	SD
1	Gasketing	5050 @ Head & Jambs		NA
2	Door Sweep	C627 A		NA
1	Saddle Threshold	Per Detail	AL	NA
1	Drip Cap	16 A - 4" ODW (as required)		NA
1	Power Supply	RPSMLR2		PR
2	Door Contacts	By Access Control Supplier		
1	Card Reader	By Access Control Supplier		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to temporarily retract active door latch for authorized access. Integrate door monitoring into security system as required.

SET #011

3	Hinges	CB199 5 X 4 1/2 NRP	US32D	ST
1	Electric Hinge	CE CB199 5 X 4 1/2 18	US32D	ST
1	Exit Device	LS MLR TS 2103 X 1703A S301	630	PR
1	Cormax Core	1CDX Series	626	BE
1	Rim Cylinder	12E-72 L/C	626	BE
1	Door Closer	CLD-4550 HCS	689	SD
1	Kick Plate	KO050 12" x 2" LDW x CSK B4E	630	TR
1	Door Stop	1475	626	DJ
1	Gasketing	5050 @ Head & Jambs		NA
1	Door Bottom	600A		NA
1	Saddle Threshold	Per Detail	AL	NA
1	Power Supply	RPSMLR2		PR
1	Door Contacts	By Access Control Supplier		
1	Card Reader	By Access Control Supplier		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to temporarily retract latch for authorized access.

NOTE: Integrate door monitoring into security system as required.

SET #012 - Overhead Door

NOTE: All hardware provided by door manufacturer.

SET #013 - Curtain Wall Door

1	Door Contacts	By Access Control Supplier
1	Junction Box	By Electrical
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES

NOTE: Integrate door monitoring into security system as required.

NOTE: Balance of hardware provided by door manufacturer.

SET #014 - 110.12

NOTE: Verify and provide hardware as required.

SET #015

2	Continuous Hinge	661 CE-58 x Sch Opt	AL	ST
1	Exit Device	TS 2601 10'0" LD	630	PR
1	Exit Device	TS 2603 10'0" LD	630	PR
1	Rim Cylinder	12E-72 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
2	Offset Pull	1191-4	630	TR
2	Door Closer	CLD-4551 TJ x P45-180	689	SD
2	Overhead Stop & Holder	1010 SL Series	US32D	AB
1	Weatherstrip	By Alum. Storefront Mfg.		
1	Bumper Seal Threshold	896S	AL	NA
2	Door Contacts	By Access Control Supplier		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Integrate door monitoring into security system as required.

SET #016

7	Hinges	CB199 4 1/2 X 4 1/2 NRP	US26D	ST
1	Electric Hinge	CE CB199 4 1/2 X 4 1/2 NRP 18	US26D	ST
1	Coordinator	3094 Series x Filler Bar x Brackets		TR
1	Set Auto Flush Bolts	3810 X 3810	630	TR
1	Electro-mech Lock	45HW-7DEU15H L/C 7/8"LTC IDH	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
2	Door Closer	CLD-4550 HCS	689	SD
1	Length Adhesive Seal	S772BL		PE
1	Astragal	139SSTB (Pull side active leaf)	US32D	NA
1	Gasketing	5050 @ Head & Jambs		NA
1	Bumper Seal Threshold	950S	AL	NA
1	Drip Cap	16 A - 4" ODW (as required)		NA
1	Door Contacts	By Access Control Supplier		
1	Power Supply	By Access Control Supplier		
1	Card Reader	By Access Control Supplier		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to temporarily release lever for authorized access. Integrate door monitoring into security system as required.

SET #017

3	Hinges	CB199 4 1/2 X 4 1/2 NRP	US26D	ST
1	Electric Hinge	CE CB199 4 1/2 X 4 1/2 NRP 18	US26D	ST
1	Electro-mech Lock	45HW-7DEU15H L/C IDH	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Latch Protector	CLP-110	630	DJ
1	Door Closer	CLD-4550 HCS	689	SD
1	Gasketing	5050 @ Head & Jambs		NA
1	Bumper Seal Threshold	950S	AL	NA
1	Drip Cap	16 A - 4" ODW (as required)		NA
1	Power Supply	By Access Control Supplier		
1	Door Contacts	By Access Control Supplier		
1	Card Reader	By Access Control Supplier		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to temporarily release lever for authorized access. Integrate door monitoring into security system as required.

SET #018

4	Hinges	CB199 4 1/2 X 4 1/2 NRP	US26D	ST
1	Storeroom Lockset	45H-7D15H L/C	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Latch Protector	CLP-110	630	DJ
1	Door Closer	CLD-4550 HCS	689	SD
1	Gasketing	5050 @ Head & Jambs		NA
1	Bumper Seal Threshold	950S	AL	NA
1	Drip Cap	16 A - 4" ODW (as required)		NA

SET #019

6	Hinges	CB199 4 1/2 X 4 1/2 NRP	US26D	ST
2	Electric Hinge	CE CB199 4 1/2 X 4 1/2 NRP 18	US26D	ST
1	Removable Mullion	KR822 MCS	689	PR
1	Exit Device	LS TS 2101 LD S301	630	PR
1	Exit Device	LS MLR TS 2103 X 1703A S301	630	PR
2	Rim Cylinder	12E-72 L/C	626	BE
2	Cormax Core	1CDX Series	626	BE

2	Door Closer	CLD-4550 HCS	689	SD
1	Mullion Seal	5100 S		NA
1	Gasketing	5050 @ Head & Jambs		NA
1	Bumper Seal Threshold	950S	AL	NA
1	Drip Cap	16 A - 4" ODW (as required)		NA
1	Power Supply	RPSMLR2		PR
2	Door Contacts	By Access Control Supplier		
1	Card Reader	By Access Control Supplier		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to temporarily retract active door latch for authorized access. Integrate door monitoring into security system as required.

SET #020 - Blow Open | CR

1	Continuous Hinge	661 CE-58 x Sch Opt	AL	ST
1	Exit Device	LS MLR TS 2103 X 1703A S301	630	PR
1	Cormax Core	1CDX Series	626	BE
1	Rim Cylinder	12E-72 L/C	626	BE
1	Pneumatic Closer	4820	689	LC
1	Control Box	7901		LC
1	Blow Open Box	ES7949		LC
1	Compressor	921 (50’ maximum distance from door)		LC
1	Tubing	925 (as required)		LC
1	Door Position Switch Kit	4820-3377		LC
1	Door Stop	1475	626	DJ
1	Gasketing Set	Per Detail		
1	Door Sweep	C627 A		NA
1	Threshold	Per Detail	AL	NA
1	Drip Cap	16 A - 4" ODW (as required)		NA
1	Power Supply	RPSMLR2		PR
1	Door Contacts	By Access Control Supplier		
1	Card Reader	By Access Control Supplier		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to temporarily retract latch for authorized access.

NOTE: Integrate separate Blow Open system into fire alarm. Compressor tank to be 50’ maximum distance from opening.

NOTE: Integrate door monitoring into security system as required.

SET #021 - 265.2

NOTE: Verify and provide hardware as required.

SET #100

4	Hinges	CB168 4 1/2 X 4 1/2 NRP	US26D	ST
1	Exit Device	FL 2114 X 4914A S301	630	PR
1	Door Closer	CLD-4551 REG	689	SD
1	Wall Bumper	1270CX	626	TR
1	Gasketing	5050 @ Head & Jambs		NA
1	Threshold	Per Detail	AL	NA

SET #101

4	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Push Plate - Engraved PUSH	1802-25-PH	630	TR
1	Pul Plate - Engraved PULL	1802-25-PL	630	TR
1	Door Closer	CLD-4551 REG	689	SD
1	Mop Plate	KO050 6" x 1" LDW x CSK B4E	630	TR
1	Floor Stop	1211	626	TR
1	Threshold	Per Detail	AL	NA
3	Door Silencers	1229 Series		TR

SET #102

4	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Storeroom Lockset	45H-7D15H L/C	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
3	Door Silencers	1229 Series		TR
1	Threshold	Per Detail	AL	NA

SET #103

4	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Storeroom Lockset	45H-7D15H L/C	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Door Closer	CLD-4550 PA	689	SD
1	Wall Bumper	1270CX	626	TR
1	Gasketing	5050 @ Head & Jambs		NA
1	Bumper Seal Threshold	950S	AL	NA

SET #104

4	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Exit Device	FL 2103 X 4903A S301	630	PR
1	Cormax Core	1CDX Series	626	BE
1	Rim Cylinder	12E-72 L/C	626	BE
1	Door Closer	CLD-4550 PA	689	SD
1	Wall Bumper	1270CX	626	TR
1	Gasketing	5050 @ Head & Jambs		NA
1	Bumper Seal Threshold	950S	AL	NA

SET #105

4	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Privacy Set | Indicator	45H-0L15H VIN VIT	630	BE
1	Door Closer	CLD-4551 REG	689	SD
1	Floor Stop	1211	626	TR
1	Gasketing	5050 @ Head & Jambs		NA
1	Perimeter Seal	156S @ Head & Jambs		NA
1	Auto Door Bottom	423N or 320S (as required)		NA
1	Bumper Seal Threshold	950S	AL	NA

SET #106

4	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Storeroom Lockset	45H-7D15H L/C	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Door Closer	CLD-4551 REG	689	SD
1	Wall Bumper	1270CX	626	TR
3	Door Silencers	1229 Series		TR

SET #107 - Glass Door

1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE

NOTE: Balance of hardware provided by door manufacturer. Verify locking as required.

SET #108 - Glass Door | Pair

2	Mortise Cylinder	1E-74 L/C	626	BE
2	Cormax Core	1CDX Series	626	BE

NOTE: Balance of hardware provided by door manufacturer. Verify locking as required.

SET #109 - Glass | Pair | CR

2	Mortise Cylinder	1E-74 L/C	626	BE
2	Cormax Core	1CDX Series	626	BE
1	Power Supply	By Access Control Supplier		
1	Card Reader	By Access Control Supplier		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to release locking device for authrozed access. Balance of hardware and electro-mechanical hardware provided by door manufacturer.

SET #110

4	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Storeroom Lockset	45H-7D15H L/C	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Wall Bumper	1270CX	626	TR
3	Door Silencers	1229 Series		TR

SET #111 - Eliason Door

NOTE: All hardware provided by door manufacturer.

SET #112

4	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Storeroom Lockset	45H-7D15H L/C	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Door Closer	CLD-4551 REG	689	SD
1	Floor Stop	1211	626	TR
1	Gasketing	5050 @ Head & Jambs		NA

SET #112A

3	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Electric Hinge	CE CB179 4 1/2 X 4 1/2 18	US26D	ST
1	Electro-mech Lock	45HW-7DEU15H L/C IDH	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Door Closer	CLD-4551 REG	689	SD
1	Floor Stop	1211	626	TR
1	Gasketing	5050 @ Head & Jambs		NA
1	Power Supply	By Access Control Supplier		
1	Door Contacts	By Access Control Supplier		
1	Card Reader	By Access Control Supplier		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to release lever for authorized access. Integrate door monitoring into security system as required.

SET #112B - Fry Reglet Door

NOTE: All hardware provided by door manufacturer.

SET #113

2	Hinges	CB191 4 1/2 X 4 1/2 NRP	US32D	ST
2	Spring Hinges	2060R 4 1/2 X 4 1/2	US32D	ST
1	Privacy Set | Indicator	45H-0L15H VIN VIT	630	BE
1	Kick Plate	KO050 12" x 2" LDW x CSK B4E	630	TR
1	Mop Plate	KO050 6" x 1" LDW x CSK B4E	630	TR
1	Wall Bumper	1270CX	626	TR

SET #114

4	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Office Lockset	45H-7A15H L/C	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Wall Bumper	1270CX	626	TR
3	Door Silencers	1229 Series		TR

SET #115

4	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Office Lock	45H-7AT15H L/C	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Wall Bumper	1270CX	626	TR
1	Gasketing Set	Per Detail		

SET #116

4	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Office Lockset	45H-7A15H L/C	630	BE
1	Cormax Core	1CDX Series	626	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Door Closer	CLD-4551 H	689	SD
3	Door Silencers	1229 Series		TR
1	Floor Stop	1211	626	TR

SET #116A

3	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Electric Hinge	CE CB179 4 1/2 X 4 1/2 18	US26D	ST
1	Electro-mech Lock	45HW-7DEU15H L/C IDH	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Door Closer	CLD-4551 REG	689	SD
1	Floor Stop	1211	626	TR
3	Door Silencers	1229 Series		TR
1	Power Supply	By Access Control Supplier		
1	Door Contacts	By Access Control Supplier		
1	Card Reader	By Access Control Supplier		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to release lever for authorized access. Integrate door monitoring into security system as required.

SET #117

3	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Elecric Hinge	CE CB179 4 1/2 X 4 1/2 18	US26D	ST
1	Electro-mech Lock	45HW-7DEU15H L/C IDH	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Door Closer	CLD-4550 PA	689	SD
1	Wall Bumper	1270CX	626	TR
3	Door Silencers	1229 Series		TR
1	Power Supply	By Access Control Supplier		
1	Door Contacts	By Access Control Supplier		
1	Card Reader	By Access Control Supplier		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to release lever for authorized access. Integrate door monitoring into security system as required.

SET #118

4	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Privacy Set | Indicator	45H-0L15H VIN VIT	630	BE
1	Door Closer	CLD-4550 PA	689	SD
1	Wall Bumper	1270CX	626	TR
1	Gasketing	5050 @ Head & Jambs		NA
1	Auto Door Bottom	423N or 320S (as required)		NA
1	Threshold	Per Detail	AL	NA

SET #119

8	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Flush Top Bolt	3916	626	TR
1	Flush Bottom Bolt	3913	626	TR
1	Dustproof Strike	3910 or 3910N (as required)	630	TR
1	Office Lockset	45H-7A15H L/C	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Door Closer	CLD-4551 H	689	SD
1	Wall Bumper	1270CX	626	TR
2	Door Silencers	1229 Series		TR

NOTE: Closer on active door only.

SET #120

3	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Elecric Hinge	CE CB179 4 1/2 X 4 1/2 18	US26D	ST
1	Electro-mech Lock	45HW-7DEU15H L/C IDH	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Door Closer	CLD-4551 REG	689	SD
1	Wall Bumper	1270CX	626	TR
3	Door Silencers	1229 Series		TR
1	Power Supply	By Access Control Supplier		
1	Door Contacts	By Access Control Supplier		
1	Card Reader	By Access Control Supplier		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to release lever for authorized access. Integrate door monitoring into security system as required.

SET #121

4	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Storeroom Lockset	45H-7D15H L/C	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Door Closer	CLD-4550 PA	689	SD
1	Wall Bumper	1270CX	626	TR
1	Gasketing	5050 @ Head & Jambs		NA

SET #122

7	Hinges	CB199 4 1/2 X 4 1/2 NRP	US26D	ST
1	Electric Hinge	CE CB199 4 1/2 X 4 1/2 NRP 18	US26D	ST
1	Coordinator	3094 Series x Filler Bar x Brackets		TR
1	Set Auto Flush Bolts	3815L X 3815L	630	TR
1	Electro-mech Lock	45HW-7DEU15H L/C 7/8"LTC IDH	630	BE
1	Cormax Core	1CDX Series	626	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
2	Door Closer	CLD-4550 HCS	689	SD
1	Astragal	139SSTB (Pull side active leaf)	US32D	NA
1	Gasketing Set	Per Detail		
1	Bumper Seal Threshold	950S	AL	NA
2	Door Contacts	By Access Control Supplier		
1	Power Supply	RPSMLR2		PR
1	Card Reader	By Access Control Supplier		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to temporarily release lever for authorized access.

NOTE: Integrate door monitoring into security system as required.

SET #123

2	Anchor Hinge Set	CB222 5 x 4 1/2	US26D	ST
1	Electric Hinge	CE CB199 5 X 4 1/2 18	US32D	ST
1	Hinges	CB199 5 X 4 1/2 NRP	US32D	ST
1	Coordinator	3094 Series x Filler Bar		TR
1	Dustproof Strike	3910 or 3910N (as required)	630	TR
1	Office Lockset	45HW-7A15H L/C	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
2	Door Closer	CLD-4551 REG	689	SD
2	Magnetic Holders	2100	630	AB
1	Astragal	139SSTB (push side in-active leaf)	US32D	NA
1	Gasketing	5050 @ Head & Jambs		NA
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Integrate magnetic holder into fire alarm system.

SET #124

8	Hinges	FBB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Coordinator	3094 Series x Filler Bar x Brackets		TR
1	Set Auto Flush Bolts	3815L X 3815L	630	TR
1	Dustproof Strike	3910 or 3910N (as required)	630	TR
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Office Lockset	45H-7A15H L/C	630	BE
2	Door Closer	CLD-4550 HCS	689	SD
2	Kick Plate	KO050 12" x 2" LDW x CSK B4E	630	TR
2	Door Silencers	1229 Series		TR

SET #125

4	Hinges	FBB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Office Lockset	45H-7A15H L/C	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Door Closer	CLD-4550 HCS	689	SD
1	Kick Plate	KO050 12" x 2" LDW x CSK B4E	630	TR
1	Mop Plate	KO050 6" x 1" LDW x CSK B4E	630	TR
1	Gasketing Set	Per Detail		

SET #126

4	Hinges	CB168 4 1/2 X 4 1/2 NRP	US26D	ST
1	Exit Device	2110 X 4908A LD S301	630	PR
1	Rim Cylinder	12E-72 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Door Closer	CLD-4550 HCS	689	SD
1	Wall Bumper	1270CX	626	TR
3	Door Silencers	1229 Series		TR

SET #127 - Operable Partition Door

NOTE: All hardware provided by door manufacturer.

SET #128 - Barn Door

NOTE: All hardware provided by door supplier.

SET #129

8	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Coordinator	3094 Series x Filler Bar		TR
1	Set Auto Flush Bolts	3815L X 3815L	630	TR
1	Dustproof Strike	3910 or 3910N (as required)	630	TR
1	Storeroom Lockset	45H-7D15H L/C	630	BE
2	Door Closer	CLD-4551 REG	689	SD
1	Wall Bumper	1270CX	626	TR
1	Gasketing	5050 @ Head & Jambs		NA

SET #130

3	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Elecric Hinge	CE CB179 4 1/2 X 4 1/2 18	US26D	ST
1	Electro-mech Lock	45HW-7DEU15H L/C IDH	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Door Closer	CLD-4551 REG	689	SD
1	Wall Bumper	1270CX	626	TR
1	Gasketing	5050 @ Head & Jambs		NA
1	Power Supply	By Access Control Supplier		
1	Door Contacts	By Access Control Supplier		
1	Card Reader	By Access Control Supplier		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to temporarily release lever for authorized access. Integrate door monitoring into security system as required.

SET #131

4	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Storeroom Lockset	45H-7D15H L/C	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Wall Bumper	1270CX	626	TR
1	Gasketing	5050 @ Head & Jambs		NA
1	Bumper Seal Threshold	950S	AL	NA

SET #132

3	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Elecric Hinge	CE CB179 4 1/2 X 4 1/2 18	US26D	ST
1	Electro-mech Lock	45HW-7DEU15H L/C IDH	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Door Closer	CLD-4551 REG	689	SD
1	Wall Bumper	1270CX	626	TR
1	Gasketing	5050 @ Head & Jambs		NA
1	Bumper Seal Threshold	950S	AL	NA
1	Power Supply	By Access Control Supplier		
1	Door Contacts	By Access Control Supplier		
1	Card Reader	By Access Control Supplier		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to temporarily release lever for authorized access. Integrate door monitoring into security system as required.

SET #133

4	Hinges	FBB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Storeroom Lockset	45H-7D15H L/C	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Door Closer	CLD-4550 HCS	689	SD
1	Kick Plate	KO050 12" x 2" LDW x CSK B4E	630	TR
1	Gasketing	5050 @ Head & Jambs		NA

SET #134

4	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Office Lockset	45H-7A15H L/C	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Closer	CLD-4550 HCS	AL	SD
1	Kick Plate	KO050 12" x 2" LDW x CSK B4E	630	TR
1	Mop Plate	KO050 6" x 1" LDW x CSK B4E	630	TR
1	Wall Bumper	1270CX	626	TR
3	Door Silencers	1229 Series		TR

SET #135

4	Hinges	CB191 4 1/2 X 4 1/2 NRP	US32D	ST
1	Passage Set	45H-0N15H	630	BE
1	Door Closer	CLD-4550 HCS	689	SD
1	Kick Plate	KO050 12" x 2" LDW x CSK B4E	630	TR
1	Mop Plate	KO050 6" x 1" LDW x CSK B4E	630	TR
1	Wall Bumper	1270CX	626	TR
1	Gasketing Set	Per Detail		

SET #136

4	Hinges	CB191 4 1/2 X 4 1/2 NRP	US32D	ST
1	Passage Set	45H-0N15H	630	BE
1	Kick Plate	KO050 12" x 2" LDW x CSK B4E	630	TR
1	Mop Plate	KO050 6" x 1" LDW x CSK B4E	630	TR
1	Wall Bumper	1270CX	626	TR
1	Gasketing Set	Per Detail		

SET #137

4	Hinges	CB191 4 1/2 X 4 1/2 NRP	US32D	ST
1	Passage Set	45H-0N15H	630	BE
1	Door Closer	CLD-4550 H-EDA	689	SD
1	Kick Plate	KO050 12" x 2" LDW x CSK B4E	630	TR
1	Mop Plate	KO050 6" x 1" LDW x CSK B4E	630	TR
1	Wall Bumper	1270CX	626	TR
1	Gasketing Set	Per Detail		

SET #138

4	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Privacy Set | Indicator	45H-0L15H VIN VIT	630	BE
1	Door Closer	CLD-4550 PA	689	SD
1	Wall Bumper	1270CX	626	TR
1	Gasketing	5050 @ Head & Jambs		NA
1	Saddle Threshold	425	AL	NA

SET #139

3	Hinges	CB199 4 1/2 X 4 1/2 NRP	US26D	ST
1	Electric Hinge	CE CB199 4 1/2 X 4 1/2 NRP 18	US26D	ST
1	Electro-mech Lock	45HW-7DEU15H L/C IDH	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Door Closer	CLD-4550 HCS	689	SD
1	Kick Plate	KO050 12" x 2" LDW x CSK B4E	630	TR
1	Gasketing Set	Per Detail		
1	Power Supply	By Access Control Supplier		
1	Door Contacts	By Access Control Supplier		
1	Card Reader	By Access Control Supplier		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to temporarily release lever for authorized access. Integrate door monitoring into security system as required.

SET #140

8	Hinges	CB191 4 1/2 X 4 1/2 NRP	US32D	ST
1	Coordinator	3094 Series x Filler Bar		TR
1	Set Auto Flush Bolts	3810 X 3810	630	TR
1	Dustproof Strike	3910 or 3910N (as required)	630	TR
1	Office Lockset	45H-7A15H L/C	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
2	Door Closer	CLD-4551 H	689	SD
1	Wall Bumper	1270CX	626	TR
1	Gasketing	5050 @ Head & Jambs		NA

SET #141

4	Hinges	CB191 4 1/2 X 4 1/2 NRP	US32D	ST
1	Storeroom Lockset	45H-7D15H L/C	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Door Closer	CLD-4550 HCS	689	SD
1	Gasketing	5050 @ Head & Jambs		NA
1	Bumper Seal Threshold	950S	AL	NA

SET #142 - Cold Room Door

NOTE: All hardware provided by door manufacturer.

SET #143

8	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Coordinator	3094 Series x Filler Bar		TR
1	Set Auto Flush Bolts	3810 X 3810	630	TR
1	Dustproof Strike	3910 or 3910N (as required)	630	TR
1	Storeroom Lockset	45H-7D15H L/C	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
2	Door Closer	CLD-4551 REG	689	SD
1	Wall Bumper	1270CX	626	TR
1	Length Adhesive Seal	S772BL		PE
1	Gasketing	5050 @ Head & Jambs		NA

SET #144

NOTE: Verify and provide hardware as required for fork lift access.

SET #145

3	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Elecric Hinge	CE CB179 4 1/2 X 4 1/2 18	US26D	ST
1	Electro-mech Lock | Fail Safe	45HW-7DEL15H L/C IDH	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Door Closer	CLD-4551 REG	689	SD
1	Wall Bumper	1270CX	626	TR
1	Gasketing	5050 @ Head & Jambs		NA
1	Power Supply	By Access Control Supplier		
1	Door Contacts	By Access Control Supplier		
1	Card Reader	By Access Control Supplier		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to temporarily release lever for authorized access. Integrate fail safe lockset into fire alarm to release lever for emergency access. Integrate door monitoring into security system as required.

SET #146

4	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Passage Set	45H-0N15H	630	BE
1	Door Closer	CLD-4551 REG	689	SD
1	Wall Bumper	1270CX	626	TR
1	Gasketing	5050 @ Head & Jambs		NA
1	Saddle Threshold	425	AL	NA

SET #147

3	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Elecric Hinge	CE CB179 4 1/2 X 4 1/2 18	US26D	ST
1	Electro-mech Lock | Fail Safe	45HW-7DEL15H L/C IDH	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Door Closer	CLD-4551 REG	689	SD
1	Wall Bumper	1270CX	626	TR
1	Gasketing	5050 @ Head & Jambs		NA
1	Power Supply	By Access Control Supplier		
1	Door Contacts	By Access Control Supplier		
1	Card Reader	By Access Control Supplier		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to temporarily release lever for authorized access. Integrate fail safe lockset into fire alarm to release lever for emergency access. Integrate door monitoring into security system as required.

SET #148

2	Continuous Hinge	661 CE-58 x Sch Opt	AL	ST
1	Exit Device	TS 2601 10'0" LBR LD	630	PR
1	Exit Device	MLR TS 2603 10'0" LBR	630	PR
1	Cormax Core	1CDX Series	626	BE
1	Rim Cylinder	12E-72 L/C	626	BE
2	Offset Pull	1191-4	630	TR
2	Door Closer	CLD-4551 TJ x P45-180	689	SD
1	Weatherstrip	By Alum. Storefront Mfg.		
1	Threshold	Per Detail	AL	NA
1	Power Supply	RPSMLR2		PR
1	Door Contacts	By Access Control Supplier		
1	Card Reader	By Access Control Supplier		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to temporarily retract active door latch for authorized access.

NOTE: Integrate door monitoring into security system as required.

SET #149 - Lab Door

8	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Flush Top Bolt	3916	626	TR
1	Flush Bottom Bolt	3913	626	TR
1	Dustproof Strike	3910 or 3910N (as required)	630	TR
1	Passage Latchset	45H-0N15H	630	BE
1	Door Closer	CLD-4550 HCS	689	SD
2	Kick Plate	KO050 12" x 2" LDW x CSK B4E	630	TR
2	Mop Plate	KO050 6" x 1" LDW x CSK B4E	630	TR
1	Wall Bumper	1270CX	626	TR
1	Gasketing Set	Per Detail		

NOTE: Closer on active leaf.

SET #150 - Lab Door | CR

8	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Flush Top Bolt	3916	626	TR
1	Flush Bottom Bolt	3913	626	TR
1	Dustproof Strike	3910 or 3910N (as required)	630	TR
1	Electro-mech Lock	45HW-7DEU15H L/C 7/8"LTC IDH	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Door Closer	CLD-4550 HCS	689	SD

2	Kick Plate	KO050 12" x 2" LDW x CSK B4E	630	TR
2	Mop Plate	KO050 6" x 1" LDW x CSK B4E	630	TR
1	Wall Bumper	1270CX	626	TR
1	Gasketing Set	Per Detail		
1	Power Supply	By Access Control Supplier		
1	Door Contacts	By Access Control Supplier		
1	Card Reader	By Access Control Supplier		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Closer on active leaf.

SET #151

7	Hinges	CB199 4 1/2 X 4 1/2 NRP	US26D	ST
1	Electric Hinge	CE CB199 4 1/2 X 4 1/2 NRP 18	US26D	ST
1	Coordinator	3094 Series x Filler Bar x Brackets		TR
1	Set Auto Flush Bolts	3815L X 3815L	630	TR
1	Electro-mech Lock	45HW-7DEU15H L/C 7/8"LTC IDH	630	BE
1	Cormax Core	1CDX Series	626	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
2	Door Closer	CLD-4550 PA	689	SD
1	Wall Bumper	1270CX	626	TR
1	Astragal	139SSTB (Pull side active leaf)	US32D	NA
1	Gasketing Set	Per Detail		
1	Bumper Seal Threshold	950S	AL	NA
2	Door Contacts	By Access Control Supplier		
1	Power Supply	RPSMLR2		PR
1	Card Reader	By Access Control Supplier		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to temporarily release lever for authorized access.

NOTE: Integrate door monitoring into security system as required.

SET #152

4	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Office Lockset	45H-7A15H L/C	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Door Closer	CLD-4550 PA	689	SD
1	Kick Plate	KO050 12" x 2" LDW x CSK B4E	630	TR
1	Mop Plate	KO050 6" x 1" LDW x CSK B4E	630	TR
1	Wall Bumper	1270CX	626	TR
1	Gasketing	5050 @ Head & Jambs		NA

SET #153

4	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Storeroom Lockset	45H-7D15H L/C	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Door Closer	CLD-4551 REG	689	SD
1	Kick Plate	KO050 12" x 2" LDW x CSK B4E	630	TR
1	Wall Bumper	1270CX	626	TR
1	Gasketing	5050 @ Head & Jambs		NA

SET #154

8	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
2	Push/Pull Set	1738	630	TR
2	Door Closer	CLD-4551 TJ x P45-180	689	SD
2	Floor Stop	1211	626	TR
1	Weatherstrip	By Alum. Storefront Mfg.		

SET #155

4	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Office Lockset	45H-7A15H L/C	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Door Closer	CLD-4550 HCS	689	SD
1	Kick Plate	KO050 12" x 2" LDW x CSK B4E	630	TR
1	Wall Bumper	1270CX	626	TR
1	Gasketing Set	Per Detail		

SET #156 - NOT USED

SET #157

4	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Office Lock	45H-7AT15H L/C	630	BE
1	Cormax Core	1CDX Series	626	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Door Closer	CLD-4550 HCS	689	SD
1	Closer Bracket	328SPB		ZE
1	Mop Plate	KO050 6" x 1" LDW x CSK B4E	630	TR
1	Kick Plate	KO050 12" x 2" LDW x CSK B4E	630	TR
1	Perimeter Seal	165SA @ Head & Jambs		NA
1	Gasketing	5050 @ Head & Jambs		NA
1	Auto Door Bottom	423N or 320S (as required)		NA
1	Bumper Seal Threshold	950S	AL	NA

SET #158 - Lab Door | Light

8	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Flush Top Bolt	3916	626	TR
1	Flush Bottom Bolt	3913	626	TR
1	Passage Latchset	45H-0N15H 7/8"LTC	630	BE
1	Door Closer	CLD-4550 HCS	689	SD
1	Closer Bracket	328SPB		ZE
2	Kick Plate	KO050 12" x 2" LDW x CSK B4E	630	TR
2	Mop Plate	KO050 6" x 1" LDW x CSK B4E	630	TR
1	Wall Bumper	1270CX	626	TR
1	Astragal	139SSTB (Pull side active leaf)	US32D	NA
1	Length Adhesive Seal	S772BL		PE
1	Perimeter Seal	165SA @ Head & Jambs		NA
1	Gasketing	5050 @ Head & Jambs		NA
1	Bumper Seal Threshold	950S	AL	NA

SET #159

3	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Elecric Hinge	CE CB179 4 1/2 X 4 1/2 18	US26D	ST
1	Electro-mech Lock	45HW-7DEU15H L/C IDH	630	BE
1	Cormax Core	1CDX Series	626	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Door Closer	CLD-4551 REG	689	SD
1	Wall Bumper	1270CX	626	TR
1	Mop Plate	KO050 6" x 1" LDW x CSK B4E	630	TR
1	Kick Plate	KO050 12" x 2" LDW x CSK B4E	630	TR
1	Gasketing	5050 @ Head & Jambs		NA
1	Power Supply	By Access Control Supplier		
1	Card Reader	By Access Control Supplier		
1	Door Contacts	By Access Control Supplier		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to temporarily release lever for authorized access.

NOTE: Integrate door monitoring into security system as required.

SET #160

6	Hinge	CB179 4 1/2 X 4 1/2	US26D	ST
2	Electric Hinge	CE CB179 4 1/2 X 4 1/2 18	US26D	ST
2	Exit Device	TS 2801 LBR or TS 2701 LBR (as required)	630	BE
2	Closers	CLD-4550 HCS		SD
2	Silencers	1229 Series		TR
2	Door Contacts	By Access Control Supplier		
1	Card Reader	By Access Control Supplier		
1	Local Alarm	By Access Control Supplier		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to temporarily shunt alarm for authorized access in both directions. Exit devices to provide free egress regardless of alarm.

NOTE: Integrate door monitoring into security system as required.

NOTE: Doors to be manually held open as required when not alarmed.

SET #161

4	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Office Lockset	45H-7A15H L/C	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Door Closer	CLD-4551 REG	689	SD
1	Wall Bumper	1270CX	626	TR
1	Gasketing Set	Per Detail		

SET #162

4	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Office Lockset	45H-7A15H L/C	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Closer	CLD-4551 REG	AL	SD
1	Floor Stop	1211	626	TR
1	Gasketing Set	Per Detail		

NOTE: Verify closer as required.

SET #163

4	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Storeroom Lockset	45H-7D15H L/C	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Wall Bumper	1270CX	626	TR
1	Gasketing Set	Per Detail		

SET #164

8	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Coordinator	3094 Series x Filler Bar x Brackets		TR
1	Set Auto Flush Bolts	3815L X 3815L	630	TR
1	Dustproof Strike	3910 or 3910N (as required)	630	TR
1	Storeroom Lockset	45H-7D15H L/C 7/8"LTC	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
2	Door Closer	CLD-4550 PA	689	SD
1	Wall Bumper	1270CX	626	TR
1	Astragal	139SSTB (Pull side active leaf)	US32D	NA
1	Gasketing	5050 @ Head & Jambs		NA

SET #165

4	Hinges	CB168 4 1/2 X 4 1/2 NRP	US26D	ST
1	Storeroom Lockset	45H-7D15H L/C	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Door Closer	CLD-4550 HCS	689	SD
1	Gasketing	5050 @ Head & Jambs		NA

SET #166

4	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Office Lockset	45H-7A15H L/C	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Door Closer	CLD-4551 REG	689	SD
1	Kick Plate	KO050 12" x 2" LDW x CSK B4E	630	TR
1	Mop Plate	KO050 6" x 1" LDW x CSK B4E	630	TR
1	Floor Stop	1211	626	TR
1	Gasketing	5050 @ Head & Jambs		NA

SET #167

1	Electric Hinge	CE CB199 4 1/2 X 4 1/2 NRP 18	US26D	ST
3	Hinges	CB199 4 1/2 X 4 1/2 NRP	US26D	ST
1	Electro-mech Lock	45HW-7DEU15H L/C IDH	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Door Closer	CLD-4550 PA	689	SD
1	Gasketing	5050 @ Head & Jambs		NA
1	Bumper Seal Threshold	950S	AL	NA
1	Card Reader	By Access Control Supplier		
1	Power Supply	By Access Control Supplier		
1	Door Contacts	By Access Control Supplier		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

SET #168

4	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Push/Pull Set	1738	630	TR
1	Door Closer	CLD-4551 TJ x P45-180	689	SD
1	Weatherstrip	By Alum. Storefront Mfg.		

SET #169 - Pocket Door

NOTE: Verify and provide hardware as required.

SET #170

4	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Passage Set	45H-0N15H	630	BE
1	Wall Bumper	1270CX	626	TR
3	Door Silencers	1229 Series		TR

SET #171 - Auto Slider

NOTE: All hardware provided by door manufacturer.

SET #172

4	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Storeroom Lockset	45H-7D15H L/C	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Door Closer	CLD-4551 REG	689	SD
1	Wall Bumper	1270CX	626	TR
1	Gasketing	5050 @ Head & Jambs		NA

SET #173

4	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Privacy Set | Indicator	45H-0L15H VIN VIT	630	BE
1	Door Closer	CLD-4551 REG	689	SD
1	Wall Bumper	1270CX	626	TR
1	Gasketing	5050 @ Head & Jambs		NA
1	Perimeter Seal	165SA @ Head & Jambs		NA
1	Auto Door Bottom	423N or 320S (as required)		NA
1	Bumper Seal Threshold	950S	AL	NA

SET #174

4	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Passage Set	45H-0N15H	630	BE
1	Kick Plate	KO050 12" x 2" LDW x CSK B4E	630	TR
1	Mop Plate	KO050 6" x 1" LDW x CSK B4E	630	TR
1	Heavy Duty Floor Stop	1214	626	TR
1	Gasketing	5050 @ Head & Jambs		NA
1	Perimeter Seal	165SA @ Head & Jambs		NA
1	Auto Door Bottom	423N or 320S (as required)		NA
1	Bumper Seal Threshold	950S	AL	NA

SET #175

8	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Manual Top Flush Bolt	3915 24”	626	TR
1	Manual Bottom Flush Bolt	3915	626	TR
1	Dustproof Strike	3910 or 3910N (as required)	630	TR
1	Office Lockset	45H-7A15H L/C	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Door Closer	CLD-4551 REG	689	SD
1	Wall Bumper	1270CX	626	TR
1	Gasketing Set	Per Detail		

NOTE: Close on active door only.

SET #176

8	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Manual Top Flush Bolt	3915 24”	626	TR
1	Manual Bottom Flush Bolt	3915	626	TR
1	Dustproof Strike	3910 or 3910N (as required)	630	TR
1	Office Lockset	45H-7A15H L/C	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Door Closer	CLD-4551 H-EDA	689	SD
1	Wall Bumper	1270CX	626	TR
1	Gasketing Set	Per Detail		

NOTE: Close on active door only.

SET #177

4	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Office Lockset	45H-7A15H L/C	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Door Closer	CLD-4551 REG	689	SD
1	Wall Bumper	1270CX	626	TR
3	Door Silencers	1229 Series		TR

SET #178

3	Hinges	CB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Electric Hinge	CE CB179 4 1/2 X 4 1/2 18	US26D	ST
1	Electro-mech Lock	45HW-7DEU15H L/C IDH	630	BE
1	Mortise Cylinder	1E-74 L/C	626	BE
1	Cormax Core	1CDX Series	626	BE
1	Door Closer	CLD-4551 REG	689	SD
1	Wall Bumper	1270CX	626	TR
1	Gasketing Set	Per Detail		
1	Power Supply	By Access Control Supplier		
1	Door Contacts	By Access Control Supplier		
1	Card Reader	By Access Control Supplier		
1	Junction Box	By Electrical		
1	Wiring & Riser Diagrams	COORDINATE WITH RELATED TRADES		

NOTE: Card reader to release lever for authorized access. Integrate door monitoring into security system as required.

END OF SECTION 087100

SECTION 087113 - AUTOMATIC DOOR OPERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes power door operators for swinging doors.

B. Related Requirements:

1. Division 08 Sections for doors and entrances that need reinforcement for automatic door operators.
2. Division 26 Sections for tie-in to power, fire alarm, and smoke detection/evacuation systems.
3. Division 28 Section “Intrusion Detection” for coordination with intrusion detection system.

1.3 DEFINITIONS

A. AAADM: American Association of Automatic Door Manufacturers.

B. Double-Swing (Doors): A pair of doors that swing with the two doors moving in opposite directions with a mullion between them; each door functioning as a single-swing door.

C. Safety Device: A control that, to avoid injury, prevents a door from opening or closing.

D. For automatic door terminology, see BHMA A156.10 for definitions of terms.

1.4 COORDINATION

A. Coordinate sizes and locations of recesses in concrete floors for recessed control mats that control automatic door operators. Concrete, reinforcement, and formwork requirements are specified elsewhere.

B. Templates: Distribute for doors, frames, and other work specified to be factory prepared and reinforced for installing automatic door operators.

C. Coordinate hardware for doors with operators to ensure proper size, thickness, hand, function, and finish.

D. Electrical System Roughing-in: Coordinate layout and installation of automatic door operators with connections to power supplies, access-control system, fire alarm systems, and smoke detection/evacuation systems.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for automatic door operators.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For automatic door operators.

1. Include plans, elevations, sections, hardware mounting heights, and attachment details.
2. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Indicate locations of activation and safety devices.
4. Include diagrams for power, signal, and control wiring.
5. Include plans, elevations, sections, and attachment details for guide rails.

C. Samples: For each exposed product and for each color and texture specified, manufacturer's standard size.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Product Certificates: For each type of automatic door operator.

C. Field quality-control reports.

D. Sample Warranties: For manufacturer's special warranties.

1.8 CLOSEOUT SUBMITTALS

A. Maintenance Data: For automatic door operators, safety devices, and control systems, to include in maintenance manuals.

1.9 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of automatic door operators that have been used for similar applications with successful results, that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports. Manufacturer shall have factory-authorized service representatives who are available for consultation, periodic Project-site observations, and on-site assistance.

B. Installer Qualifications: A firm with not less than 10 years' experience installing automatic door operators similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of automatic door operators that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Faulty or sporadic operation of automatic door operator, including controls.
b. Deterioration of metals, metal finishes, and other materials beyond normal weathering or use.

2. Warranty Period: Four years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Besam Entrance Solutions; ASSA ABLOY.
2. LCN; an Allegion brand.
3. Stanley Access Technologies.

B. Source Limitations: Obtain automatic door operators, including activation and safety devices, from single source from single manufacturer.

2.2 AUTOMATIC DOOR OPERATORS, GENERAL

A. General: Provide operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for occupancy type indicated; and according to UL 325. Coordinate operator mechanisms with door operation, hinges, and activation and safety devices.

B. Electromechanical Operating System: Self-contained unit powered by permanent-magnet dc motor; with closing speed controlled mechanically by gear train and dynamically by braking action of electric motor, connections for power and activation- and safety-device wiring, and manual operation including spring closing when power is off.

C. Hinges: See Section 087100 "Door Hardware" for hinge type for each door that door operator shall accommodate.

D. Housing for Overhead Concealed Operators: Fabricated from minimum 0.125-inch-thick, extruded or formed aluminum and extending full width of door opening including door jambs to conceal door operators and controls. Provide hinged or removable access panels for service and adjustment of door operators and controls. Secure panels to prevent unauthorized access.

E. Cover for Surface-Mounted Operators: Fabricated from 0.125-inch-thick, extruded or formed aluminum; continuous over full width of operator-controlled door opening; with enclosed end caps, provision for maintenance access, and fasteners concealed when door is in closed position. Match same color and finish of adjacent mullion system.

F. Brackets and Reinforcements: Fabricated from aluminum with nonstaining, nonferrous shims for aligning system components.

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.

2.3 POWER DOOR OPERATORS

A. Standard: BHMA A156.10 and Section 11B-404.3 of the 2016 California Building Code.

B. Performance Requirements:

1. Opening Force:

a. Power-Operated Swinging Doors: Not more than 30 lbf required to manually open door if power fails.
b. Power-assist door operators shall be connected to the building's stand-by or emergency power system per CBC 11B-404.2.9 Exception b. Refer to Division 26 Section(s).

2. Entrapment-Prevention Force: Not more than 40 lbf required to prevent stopped door in the last 10 degrees of opening from moving in the direction of opening; not more than 30 lbf required to prevent stopped door from moving in direction of closing.

C. Configuration: Operator to control single swinging door.

1. Traffic Pattern: Two way.
2. Operator Mounting: Overhead concealed.

D. Operation: Power opening and spring closing. Provide time delay for door to remain open before initiating closing cycle as required by BHMA A156.10.

E. Operating System: Electromechanical.

F. Microprocessor Control Unit: Solid-state controller.

G. Features:

1. Adjustable opening and closing speed.
2. Adjustable opening and closing force.
3. Adjustable backcheck.
4. Adjustable hold-open time from zero to 30 seconds.
5. Adjustable time delay.
6. Adjustable acceleration.
7. Adjustable limit switch.
8. Obstruction recycle.
9. Automatic door re-open if stopped while closing.
10. On-off/hold-open switch to control electric power to operator; key operated.

H. Controls: Activation and safety devicesaccording to BHMA standards.

1. Activation Device:

a. Push-plate switch on each side of door to activate door operator.
b. Fire alarm, smoke detection/evacuation system.

2. Safety Device: Presence sensor mounted on door header to detect pedestrians in presence zone and to prevent door from closing.
3. Safety Device: One photoelectric beam mounted in guide rails to detect pedestrians in presence zone and to prevent door from closing.
4. Safety Device: Control mat(s) installed on egress side of door to detect pedestrians in presence and safety zones and to prevent door from closing.

I. Exposed Finish: Finish matching door and frame.

1. Color: Match Architect's sample.

2.4 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Extrusions: ASTM B 221.
2. Sheet: ASTM B 209.

B. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, stretcher-leveled standard of flatness, in manufacturer's standard thickness.

C. Fasteners and Accessories: Corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

2.5 CONTROLS

A. General: Provide controls, including activation and safety devices, according to BHMA standards; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for occupancy type indicated. Coordinate activation and safety devices with door operation and door operator mechanisms.

B. Motion Sensors: Self-contained, K-band-frequency, microwave-scanner units; fully enclosed in plastic housing; adjustable to provide detection field sizes and functions required by BHMA A156.10.

1. Provide capability for switching between bidirectional and unidirectional detection.

C. Push-Plate Switch: Momentary-contact door control switch with flat push-plate actuator with contrasting-colored, engraved message.

1. Configuration: Square push plate with 4-by-4-inch junction box.

a. Mounting: As indicated on Drawings.

2. Push-Plate Material: Stainless steel as selected by Architect from manufacturer's full range.
3. Message: International symbol of accessibility.

D. Electrical Interlocks: Unless units are equipped with self-protecting devices or circuits, provide electrical interlocks to prevent activation of operator when door is locked, latched, or bolted.

E. Tie controls into building fire alarm system and smoke detection/evacuation system.

2.6 FABRICATION

A. Factory fabricate automatic door operators to comply with indicated standards.

B. Form aluminum shapes before finishing.

C. Fabricate exterior components to drain condensation and water passing joints within operator enclosure to the exterior.

D. Use concealed fasteners to greatest extent possible. Where exposed fasteners are required, use countersunk Phillips flat-head machine screws, finished to match operator.

E. Provide metal cladding, completely covering visible surfaces before shipment to Project site. Fabricate cladding with concealed fasteners and connection devices, with accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion, and with allowance for thermal expansion at exterior doors.

2.7 ACCESSORIES

A. Signage: As required by cited BHMA standard for type of door and its operation.

1. Application Process: Silk-screened.
2. Provide sign materials with instructions for field application when operators are installed.

2.8 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying strippable, temporary protective covering before shipping.

B. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within range of approved Samples and are assembled or installed to minimize contrast.

2.9 ALUMINUM FINISHES

A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances, door and frame preparation and reinforcements, and other conditions affecting performance of automatic door operators.

B. Examine roughing-in for electrical systems to verify actual locations of power connections before automatic door operator installation.

C. Examine roughing-in for compressed-air piping systems to verify actual locations of piping connections before automatic door operator installation.

D. Verify that full-height finger guards are installed at each door with pivot hinges where door has a clearance at hinge side greater than 1/4 inch and less than 3/4 inch with door in any position.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install automatic door operators according to manufacturer's written instructions and cited BHMA standard for type of door operation and direction of pedestrian travel, including signage, controls, wiring, remote power units if any, and connection to building's power supply.

1. Do not install damaged components. Fit joints to produce hairline joints free of burrs and distortion.
2. Install operators true in alignment with established lines and door geometry without warp or rack. Anchor securely in place.

B. Controls: Install activation and safety devices according to manufacturer's written instructions and cited BHMA standard for operator type and direction of pedestrian travel. Connect control wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Access-Control System: Connect operators to access-control system as specified in Section 281300 "Access Control."

D. Signage: Apply on both sides of each door as required by cited BHMA standard for type of door operator and direction of pedestrian travel.

3.3 FIELD QUALITY CONTROL

A. Certified Inspector: Engage a Certified Inspector to test and inspect components, assemblies, and installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Test and inspect each automatic door operator installation, using AAADM inspection forms, to determine compliance of installed systems with applicable BHMA standards.

C. Automatic door operators will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust automatic door operators to function smoothly, and lubricate as recommended by manufacturer; comply with requirements of applicable BHMA standards.

1. Adjust operators on exterior doors for weathertight closure.

B. After completing installation of automatic door operators, inspect exposed finishes on doors and operators. Repair damaged finish to match original finish.

C. Readjust automatic door operators and controls after repeated operation of completed installation equivalent to three days' use by normal traffic (100 to 300 cycles).

D. Occupancy Adjustment: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.5 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of automatic door operator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Engage a Certified Inspector to perform safety inspection after each adjustment or repair and at end of maintenance period. Furnish completed inspection reports to Owner.
2. Perform maintenance, including emergency callback service, during normal working hours.
3. Include 24-hour-per-day, 7-day-per-week, emergency callback service.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain automatic door operators.

END OF SECTION 087113

SECTION 088000 - GLAZING (DEFERRED APPROVAL)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Glass for interior and exterior applications where not specified in other Section(s).
2. Glazing sealants and accessories.

B. Exterior glazing is part of a “Deferred Approval.” Coordinate with the deferred approval requirements in Section 013300 “Submittal Procedures” and with the requirements indicated on the Drawings.

C. Related Requirements:

1. Section 081113 "Hollow Metal Doors and Frames" for glazing provided under this Section and factory installed within hollow metal doors and frames.
2. Section 081416 "Flush Wood Doors" and Section 081433 "Stile and Rail Wood Doors" for glazing provided under this Section and installed within wood doors.
3. Section 084113 "Interior Aluminum-Framed Storefronts" for glazing provided under this Section and field installed within aluminum-framed storefronts.
4. Section 084413 "Glazed Aluminum Curtain Walls and Entrances" for glazing provided under this Section and field installed within glazed aluminum curtain walls and entrances.
5. Section 084426 "Point-Supported Glazing Systems" for glazing provided under this Section and field installed within point-supported glazing systems.
6. Section 088300 "Mirrors."

1.3 DEFINITIONS

A. AAMA: Architectural Aluminum Manufacturers Association

1. AAMA GAG-1, Glass and Glazing
2. AAMA TIR-A4, Reflective Insulating Glass
3. AAMA CWS-12, Structural Properties of Glass

B. ASTM: American Society for Testing and Materials – Latest Edition.

1. ASTM E 997, Test Method for Structural Performance of Glass in Exterior Windows, Curtain Walls and Doors under the influence of Uniform Static Loads by Destructive Methods.
2. ASTM E 998, Test Method for Structural Performance of Glass in Exterior Windows, Curtain Walls and Doors under the influence of Uniform Static Loads by Non-destructive Methods.
3. ASTM C 1048, Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass.
4. ASTM C 1172, Standard Specification for Laminated Architectural Flat Glass.

C. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

D. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

E. CBC: 2016 California Building Code.

F. CEC: 2016 California Energy Code.

G. Interspace: Space between lites of an insulating-glass unit.

1.4 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review temporary protection requirements for glazing during and after installation.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For sealants, indicating VOC content.

C. Shop Drawings: Include the following with glazed framing shop drawings required under other Division 08 Section(s):

1. Glass types, make-up, sizes, and thicknesses.
2. Glazing materials manufacturers, products, types, and profiles.
3. Glass bite, edge clearance, and depth of rabbet.
4. Sealant thickness and profile.

D. Glass Samples: For each type of glazing type; 12 inches square.

E. Glazing Accessory Samples: For sealant and colored spacers, in 12-inch lengths. Install sealant Samples between two strips of material representative in color of the adjoining framing system.

F. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

G. Deferred-Approval Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data stamped and signed by the qualified California-licensed professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer, installer, and professional engineer.

B. Product Certificates: For each type of glass and glazing product, from manufacturer.

C. Product Test Reports: For tinted glass, insulating glass, and glazing sealants, for tests performed by a qualified testing agency.

1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.

D. Sample Warranty: For special warranty.

1.8 CLOSE-OUT SUBMITTALS

A. Maintenance Data: For inclusion maintenance manual required by appropriate Division 01 Section; include following:

1. Manufacturer's instructions for maintenance of installed work
2. Methods and frequency recommended for maintaining optimum condition under anticipated use.
3. Precautions against cleaning products and methods which may be detrimental to finishes and performance.

1.9 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of architectural glass and glazing that has been used for similar applications with successful results, that meets or exceeds performance requirements indicated, and of documenting this performance by inclusion in test reports, labels, and calculations. Manufacturer shall have factory-authorized service representatives who are available for consultation, periodic Project-site observations, and on-site assistance.

B. Installer Qualifications: A firm with not less than 10 years' experience installing interior and exterior glazing similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section. Supervisor and installing personnel shall also be "Certified Glass Installers" by the National Glass Association.

C. Engineering Responsibility: Prepare data for glazing, including Shop Drawings, based on testing and engineering analysis for manufacturer's standard units in systems similar to those indicated for the Project and submission of reports of tests performed on manufacturer's standard assemblies.

D. Safety Glazing Standard: 16 CFR 1201 for heat treated and laminated glass, permanently marked with Safety Glazing Certification Council label. Comply with the 2016 CBC.

E. Quality Standards: In addition to standards specified elsewhere, comply with following, unless otherwise specified:

1. GANA's Glazing Manual.
2. GANA's Laminated Glass Reference Manual.
3. IGMA SIGMA TM-3000 Insulating Glass Units

F. Mockups: Build mockups demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Install glazing in mockups as specified in other Section(s).
2. Construct mockup in presence of manufacturer's technical representative.
3. Measurements for glass panels used in mockups will establish fabrication tolerances for the Work.
4. Glass panels used in visual mockups will be fabricated to and representative of the same fabrication tolerances as glass panels used in the Work.
5. Testing shall be performed on mockups according to requirements in other Section(s).
6. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.10 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.

4. Test insulated glass units adhesion pull testing shall be completed at the same time of production and on the same production line using the same processing equipment for the production of the units for the Work. Testing shall be completed at each shift or carton change on units not less than 24 by 36 inches.
5. Conduct desiccant temperature rise testing in accordance with the manufacturer's written recommendations.
6. Schedule enough time for testing and analyzing results to prevent delaying the Work.
7. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.12 FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealant when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F.
2. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.13 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty on Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: 10 years from date of Substantial Completion.

C. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

D. Failures include, but are not limited to, the following:

1. Defective manufacture, fabrication, and installation.
2. Deterioration of coating, lamination, and/or hermetic seal.
3. Failure of sealants or gaskets to remain watertight and airtight.
4. Spontaneous glass breakage.
5. Glass breakage due to installation or thermal movement.
6. Scratches.
7. Pinholes in coated spandrel glass.
8. Roller wave distortions exceeding specified limits.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Manufacturers: Subject to compliance with requirements, provide products by manufacturers specified in glazing schedules below.

B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.

C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight, deterioration of glazing materials; or other defects in construction.

B. Deferred-Approval Design: Engage a qualified California-licensed professional engineer, as defined in Section 014000 “Quality Requirements,” to design exterior glazing.

1. Project Glazing Analysis: Prepared by manufacturer for primary glass or fabricator for fabricated glass units, analyze each glass type and glazing condition to comply with performance requirements and the following:

a. Thermal Analysis:

1) Evaluate effects of partial and full shading of glass under expected service temperature ranges.
2) Evaluate that specified probability of breakage, glass statistical factor, will not be reduced.

b. Wind Load Analysis: Evaluate effects of wind loading and determine design factor, statistical probability of breakage, and center deflection for largest size of each thickness and type of primary glass or fabricated glass units.
c. Heat Strengthened Glass Face Pressure: Evaluate that pressure falls within specified limits.

C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the 2016 CBC and ASTM E 1300.

1. Design Wind Pressures: As indicated on Structural Drawings.
2. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.
3. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

D. Interstory Drift: Accommodate design displacement of adjacent stories indicated.

1. Elastic and Inelastic Displacements: As indicated on Structural Drawings.
2. Test Performance: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.4 at elastic displacement and inelastic displacement.

E. Seismic Performance: Glazing shall withstand the effects of earthquake motions determined according to the 2016 California Building Code.

1. Seismic Drift Causing Glass Fallout: Complying with criteria for passing based on building occupancy type at elastic displacement and inelastic displacement when tested according to AAMA 501.6 or by engineering analysis.

F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

1. Temperature Change: 120 def F, ambient; 180 deg F, materials surfaces.

G. Safety Glazing: Where safety glazing is indicated and/or required per the CBC, provide glazing that complies with 16 CFR 1201, Category II.

H. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.
2. For laminated-glass lites, properties are based on products of construction indicated.
3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
4. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

I. Flatness Tolerances for Heat Strengthened and Tempered Glass:

1. Roller Wave Distortion or Ripple: Deviation from flatness at any peak shall not exceed 0.003 inches from peak to valley for 1/4-inch thick glass as measured per GANA test procedure TD 04-03-26 “Standard Test Method for In-Plant Measurement of Roll Wave in Heat-Treated Architectural Glass.

a. Measurement Device: LiteSentry measurement system or equal.
b. Roll Wave Criteria (Horizontal): Maximum 0.003 center / 0.008 edges (peak to valley).
c. Milidiopter Criteria (90 Percent Surface): Maximum + or - 125A overall, or the highest overall measurement from the approved visual mockp that is less than + or - 125A overall, whichever is less.

2. Bow and Warp: Bow and warp tolerances shall not exceed 1/32-inch per linear foot as measured per ASTM C 1048.

2.3 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organization below unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IgCC.

D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.

1. Minimum Glass Thickness for Exterior Lites: 6 mm.

2.4 GLASS PRODUCTS

A. Heat-Strengthened Float Glass: ASTM C 1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

B. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), heat soaked, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

C. Ceramic-Coated Spandrel Glass: ASTM C 1048, Condition B, Type I, Quality-Q3, and complying with other requirements specified.

1. Basis-of-Design Product: Subject to compliance with requirements, match same glass type as adjacent insulated vision glazing with ceramic coating applied to #4 surface.
2. Ceramic Coating Color: Match Architect’s sample.

D. Silicone-Coated Spandrel Glass: ASTM C 1048, Condition C, Type I, Quality-Q3, and complying with other requirements specified.

1. Basis-of-Design Product: Subject to compliance with requirements, match same glass type as adjacent insulated vision glazing with silicone coating applied to #4 surface.
2. Silicone Coating Color: Match Architect’s sample.

2.1 LAMINATED GLASS

A. Laminated Glass: ASTM C 1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written instructions.
2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
3. Interlayer Color: Clear unless otherwise indicated.

2.2 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.

1. Sealing System: Dual seal, with manufacturer's standard primary sealant (polyisobutylene) and secondary sealant (silicone) in accordance with ASTM C 1249.

a. Color: Black.

2. Spacer: Stainless steel.

a. Color: Black.

3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.3 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:

1. Neoprene complying with ASTM C 864.
2. EPDM complying with ASTM C 864.
3. Silicone complying with ASTM C 1115.
4. Thermoplastic polyolefin rubber complying with ASTM C 1115.

B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned neoprene, EPDM, silicone or thermoplastic polyolefin rubber gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.

1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

C. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock-strips, complying with ASTM C 542, black.

2.4 GLAZING SEALANTS

A. General:

1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Sealant shall have a VOC content of 250 g/L or less.
4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacture’s full range.

B. Glazing Sealant: As recommended by manufacturer for joint type and performance requirements indicated.

2.5 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

2.6 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.7 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

a. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

D. Glass Tolerances:

1. Squareness of panels governs other tolerances and shall be within 4.0 mm of specified dimensions.
2. Edge lengths shall be within 3.0 mm of specified dimensions.
3. Holes shall be within 1.5 mm of specified locations.
4. Bow shall be better than 0.3 percent.
5. Air Space Gap Tolerance: Plus or minus 1/16 inch at time of fabrication.

E. Glass Holes: Drilled holes shall be straight through. Fitting type shall be as shown in the Contract Documents and approved Shop Drawings. All edges of holes shall be cleaned and free of loose or ground materials.

2.8 EXTERIOR GLASS SCHEDULE

A. Low-E-Coated, Clear Insulated Glass (GL-1):

1. Basis-of-Design Product: Vitro (formerly PPG) "Solarban 90 Solar Control Low-E Glass."
2. Overall Unit Thickness: 1 inch.
3. Minimum Thickness of Each Glass Lite: 6 mm (nominal 1/4 inch).
4. Outdoor Lite: Clear heat-strengthened float glass (fully tempered where safety glazing is required).
5. Interspace Content: Air.
6. Indoor Lite: Clear heat-strengthened float glass (fully tempered where safety glazing is required).
7. Low-E Coating: Triple silver coating deposition on second surface.
8. Visible Light Transmittance: 51 percent minimum.
9. Winter Nighttime U-Factor: 0.29 maximum.
10. Solar Heat Gain Coefficient: 0.23 maximum.
11. Light-to-Solar Gain: 2.22.
12. Safety glazing required.

B. Low-E-Coated, Tinted Insulated Glass (GL-2): Not Used.

C. Low-E-Coated, Ultra-Clear Insulated Glass (GL-3 / Atrium - Vertical Glazing):

1. Basis-of-Design Product: Vitro (formerly PPG) "Solarban 90 Solar Control Low-E Glass."
2. Overall Unit Thickness: Per deferred-approval engineering calculations.
3. Minimum Thickness of Each Glass Lite: Per deferred-approval engineering calculations, but no less than 6 mm (nominal 1/4 inch) for each glass lite.
4. Outdoor Lite: Ultra-clear (Starphire) fully tempered.
5. Interspace Content: Air.
6. Indoor Lite: Ultra-clear (Starphire) fully tempered.
7. Low-E Coating: Triple silver coating deposition on second surface.
8. Visible Light Transmittance: 54 percent minimum.
9. Winter Nighttime U-Factor: 0.29 maximum.
10. Solar Heat Gain Coefficient: 0.23 maximum.
11. Light-to-Solar Gain: 2.35.
12. Safety glazing required.

D. Low-E-Coated, Ultra-Clear Laminated Insulated Glass, Fritted (GL-4 / Atrium - Horizontal/Sloped Glazing):

1. Basis-of-Design Product: Vitro (formerly PPG) ""Solarban 90 Solar Control Low-E Glass."
2. Overall Unit Thickness: Per deferred-approval engineering calculations.
3. Minimum Thickness of Each Glass Lite: Per deferred-approval engineering calculations, but no less than 6 mm (nominal 1/4 inch) for each glass lite.
4. Outdoor Lite: Ultra-clear (Starphire) fully tempered.
5. Interspace Content: Air.
6. Indoor Lites: Ultra-clear (Starphire) fully tempered and laminated.
    a. Interlayer Color: As indicated on Drawings, or if not indicated, clear.
    b. Frit Pattern: Silkscreen applied on third surface, in pattern as indicated on Drawings.
7. Low-E Coating: Triple silver coating deposition on second surface.
8. Visible Light Transmittance: 54 percent minimum.
9. Winter Nighttime U-Factor: 0.29 maximum.
10. Solar Heat Gain Coefficient: 0.23 maximum.
11. Light-to-Solar Gain: 2.35.
12. Safety glazing required.

E. Insulated Spandrel Glass (GL-1S): Ceramic- or Silicone-coated, insulated spandrel glass.

1. Same glass system as GL-1, except provide opacifier on #4 surface.
2. Color: Custom color to match Architect’s sample.

2.9 INTERIOR GLASS SCHEDULE

A. Clear Fully Tempered Float Glass (GL-10): ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
2. Minimum Thickness: As indicated on Drawings, or if not indicated, complying with the following:
    a. Lites with a maximum length of 60 inches: 6 mm (nominal 1/4 inch).
    b. Lites with a maximum length of 61-96 inches: 10 mm (nominal 3/8 inch).
    c. Lites with a maximum length of 97-120 inches: 12 mm (nominal 1/2 inch).
3. Safety glazing required.

B. Translucent Laminated Glass (GL-11): ASTM C 1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

a. GlassPro (www.glas-pro.com)

1) Type: As indicated, or if not indicated, as selected by Architect from manufacturer's full range.
2) Minimum Thickness of Each Ply: 3 mm (nominal 1/8 inch).
3) Minimum Interlayer Thickness: 0.030 inch.
4) Safety glazing required.

C. Clear Fire-Protection-Rated Glazing (GL-X)

1. Fire-Protection-Rated Glazing: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on positive-pressure testing according to NFPA 257 or UL 9, including the hose-stream test, and shall comply with NFPA 80.

a. Fire-protection-rated glazing required to have a fire-protection rating of 20 minutes shall be exempt from the hose-stream test.

2. Fire-Protection-Rated Glazing Labeling: Permanently mark each lite of fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name; test standard; whether glazing is permitted to be used in doors or openings; if permitted in openings, whether or not glazing has passed the hose-stream test; whether or not glazing meets 450 deg F (250 deg C) temperature-rise limitation; and the fire-resistance rating in minutes.
3. Laminated Glass with Intumescent Interlayers: Laminated glass made from multiple plies of uncoated, ultraclear float glass; with intumescent interlayers; and complying with 16 CFR 1201, Category II.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) AGC Glass Company North America, Inc.
2) Pilkington North America.
3) Technical Glass Products.

4. Provide glazing gaskets, glazing sealants, glazing tapes, setting blocks, spacers, edge blocks, and other glazing accessories that are compatible with glazing products and each other and are approved by testing agencies that listed and labeled fire-resistant glazing products with which products are used for applications and fire-protection ratings indicated.
5. Glazing Sealants for Fire-Rated Glazing Products: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT. Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated.

a. Sealants shall have a VOC content of 250 g/L or less.
b. Colors of Exposed Glazing Sealants: Match Architect's samples.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

A. Use methods approved by testing agencies that listed and labeled glazing products.

B. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials unless more stringent requirements are indicated, including those in referenced glazing publications.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches.

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

I. Set glass lites with proper orientation so that coatings face proper orientation as specified.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 FIELD QUALITY CONTROL

A. Field Quality-Control Testing: Conduct field quality-control testing as specified in other Section(s).

B. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

D. Glazing will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.8 CLEANING AND PROTECTION

A. Immediately after installation remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 088000

SECTION 088300 - MIRRORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes the following types of silvered flat glass mirrors:

1. Tempered glass mirrors qualifying as safety glazing.

1.3 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that mirrors can be supported and installed as indicated.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1. Mirrors. Include description of materials and process used to produce each type of silvered flat glass mirror specified that indicates sources of glass, glass coating components, edge sealer, and quality-control provisions.

B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.

C. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachments to other work.

D. Samples: For each type of the following products:

1. Mirrors: 12 inches square, including edge treatment on two adjoining edges.
2. Mirror Clips: Full size.
3. Mirror Trim: 12 inches long.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Product Certificates: For each type of mirror.

C. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITALS

A. Maintenance Data: For mirrors to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of mirrors that have been used for similar applications with successful results, that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports.

B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect mirrors according to mirror manufacturer's written instructions and as needed to prevent damage to mirrors from moisture, condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with mirror manufacturer's written instructions for shipping, storing, and handling mirrors as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not install mirrors until ambient temperature and humidity conditions are maintained at levels indicated for final occupancy.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which mirror manufacturer agrees to replace mirrors that deteriorate within specified warranty period. Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage or to maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Guardian Industries.
2. Independent Mirror Industries, Inc.
3. Lenoir Mirror Company.
4. National Glass Industries.
5. Or Equal.

B. Source Limitations for Mirrors: Obtain mirrors from single source from single manufacturer.

C. Source Limitations for Mirror Accessories: Obtain mirror glazing accessories from single source.

2.2 SILVERED FLAT GLASS MIRRORS

A. Glass Mirrors, General: ASTM C 1503; manufactured using copper-free, low-lead mirror coating process.

B. Tempered Clear Glass: Mirror Glazing Quality, for blemish requirements; and comply with ASTM C 1048 for Kind FT, Condition A, tempered float glass before silver coating is applied.

C. Sheet Mirror (Custom):

1. Nominal Thickness: Nominal 1/4 inch (6.0 mm).
2. Bevel: None.
3. Edge: Flat edge.
4. Dimensions: As indicated.

2.3 MISCELLANEOUS MATERIALS

A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

B. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.

C. Film Backing for Safety Mirrors: Film backing and pressure-sensitive adhesive; both compatible with mirror backing paint as certified by mirror manufacturer.

2.4 MIRROR HARDWARE

A. Top Channel/Cleat and Bottom Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover bottom and top edges of each mirror in a single piece.

1. Bottom Trim: J-channels formed with front leg and back leg not less than 5/16 and 3/4 inch in height, respectively.

a. Product: Subject to compliance with requirements, provide D638 FHA Type "J" Channel by Laurence, C. R. Co., Inc.

2. Top Trim: Formed with front leg with a height of 5/16 inch and back leg designed to fit into the pocket created by wall-mounted aluminum cleat.

a. Product: Subject to compliance with requirements, provide D 1638 Top Channel and D 1637M Mirror Mount System Cleat by Laurence, C. R. Co., Inc.

3. Finish: Clear bright anodized.

B. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.

C. Anchors and Inserts: Provide devices as required for mirror hardware installation. Provide toothed or lead-shield expansion-bolt devices for drilled-in-place anchors. Provide galvanized anchors and inserts for applications on inside face of exterior walls and where indicated.

2.5 FABRICATION

A. Fabricate mirrors in the shop to greatest extent possible.

B. Fabricate cutouts for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrors.

C. Mirror Edge Treatment (where exposed): Flat polished.

1. Require mirror manufacturer to perform edge treatment and sealing in factory immediately after cutting to final sizes.

D. Film-Backed Safety Mirrors: Apply film backing with adhesive coating over mirror backing paint as recommended in writing by film-backing manufacturer to produce a surface free of bubbles, blisters, and other imperfections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

3.2 INSTALLATION

A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.

B. Provide a minimum air space of 1/8 inch between back of mirrors and mounting surface for air circulation between back of mirrors and face of mounting surface.

C. Wall-Mounted Mirrors: Install mirrors with mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.

1. Top and Bottom Aluminum J-Channels: Provide setting blocks 1/8 inch thick by 4 inches long at quarter points. To prevent trapping water, provide, between setting blocks, two slotted weeps not less than 1/4 inch wide by 3/8 inch long at bottom channel.
2. Mirror Clips: Place a felt or plastic pad between mirror and each clip to prevent spalling of mirror edges. Locate clips so they are symmetrically placed and evenly spaced.

3.3 CLEANING AND PROTECTION

A. Protect mirrors from breakage and contaminating substances resulting from construction operations.

B. Do not permit edges of mirrors to be exposed to standing water.

C. Maintain environmental conditions that will prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.

D. Wash exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash mirrors as recommended in writing by mirror manufacturer.

END OF SECTION 088300

SECTION 089119 - FIXED LOUVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes fixed, extruded-aluminum louvers.

B. Related Requirements:

1. Section 076000 "Sheet Metal Flashing and Trim" for flashing to be coordinated with fixed louvers.
2. Section 081113 "Hollow Metal Doors and Frames" for louvers in hollow-metal doors where scheduled.
3. Section 081416 "Flush Wood Doors" for louvers in flush wood doors where scheduled.

1.3 DEFINITIONS

A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

B. Horizontal Louver: Louver with horizontal blades (i.e., the axes of the blades are horizontal).

C. Vertical Louver: Louver with vertical blades (i.e., the axes of the blades are vertical).

D. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

E. Wind-Driven-Rain-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: Provide project-specific shop drawings for louvers and accessories.

1. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
2. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
3. Show mullion profiles and locations.

C. Samples: For each type of metal finish required.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Date: For manufacturer and installer.

B. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

C. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of louvers that have been used for similar applications with successful results, that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports. Manufacturer shall have factory-authorized service representatives who are available for consultation, periodic Project-site observations, and on-site assistance.

B. Installer Qualifications: A firm with not less than 5 years' experience installing fixed louvers similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code - Steel."
2. AWS D1.2, "Structural Welding Code - Aluminum."

1.7 COORDINATION

A. Coordinate fixed louver installation with adjoining work to provide a leakproof, secure, and noncorrosive installation.

B. Coordinate installation of miscellaneous metal sub-framing, anchorage items, or other items to be embedded in or attached to other construction before starting that Work. Provide locations, setting diagrams, templates, instructions, and directions for installation. Deliver such items to Project site in time for installation.

1.8 FIELD CONDITIONS

A. Pre-Installation Field Measurements: Coordinate exact hardware and anchorage locations with other Trade Contractors before permanently attaching to other construction.

B. Post-Installed Field Measurements: Field verify and examine actual installed locations of connection hardware and anchorage items prior to installation of Work provided under this Section. Notify General Contractor and Architect immediately of any discrepancies in writing. Provide letter from fixed louver installer indicating acceptance of connection hardware and anchorage items.

1.9 WARRANTY

A. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, and unless otherwise indicated, provide fixed louvers by one of the following:

1. Aerolite; Model SCH401.
2. Construction Specialties, Inc.; Model RS-4700.
3. Ruskin Company; EME520DD.

B. Source Limitations: Obtain louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

2.2 PERFORMANCE REQUIREMENTS

A. General: Fixed louvers assemblies and associated flashings shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed fixed louver assemblies and associated flashings shall not rattle, leak or loosen, and shall remain watertight and prevent intrusion into the building interior.

B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

1. Wind Loads: Per the 2016 California Building Code (CBC) based upon criteria indicated on the Structural Drawings.

C. Seismic Performance: Louvers, including attachments to other construction, shall withstand the effects of earthquake motions determined according to the CBC and ASCE/SEI 7.

1. Component Importance Factor: Per the CBC.

D. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

1. Air Flow: As indicated on Drawings.

E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

F. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

2.3 FIXED, EXTRUDED-ALUMINUM LOUVERS

A. Interior Louvers:

1. Type: Sight-proof.
2. Louver Depth: As required to meet performance criterial, but no less than 4 inches.
3. Frame and Blade Nominal Thickness: Not less than 0.060 inch for blades and 0.080 inch for frames.
4. Louver Performance Ratings:

a. Free Area: As required to meet performance criteria and mechanical performance indicated.
b. Air Performance: As indicated on Drawings.

B. Exterior, Horizontal, Wind-Driven-Rain-Resistant Louver:

1. Louver Depth: As required to meet performance criteria, but no less than 4 inches.
2. Frame and Blade Nominal Thickness: Not less than 0.060 inch for blades and 0.080 inch for frames.
3. Louver Performance Ratings:

   a. Free Area: As required to meet performance criteria and mechanical performance indicated.
   b. Air Performance: As indicated on Drawings.
   c. Wind-Driven Rain Performance:

      1) Not less than 99 percent effectiveness when subjected to a rainfall rate of 3 inches per hour and a wind speed of 29 mph at a core-area intake velocity of 600 fpm. Class A effectiveness rating.
      2) Not less than 99 percent effectiveness when subjected to a rainfall rate of 8 inches per hour and a wind speed of 50 mph at a core-area intake velocity of 290 fpm. Class A effectiveness rating.

4. AMCA Seal: Mark units with AMCA Certified Ratings Seal.
5. Mullion Type: Concealed.

2.4 LOUVER SCREENS

A. General: Provide screen at each exterior louver.

1. Screen Location for Fixed Louvers: Interior face.
2. Screening Type: Insect screening.

B. Secure screen frames to louver frames with machine screws with heads finished to match louver, spaced a maximum of 6 inches from each corner and at 12 inches o.c.

C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.

D. Insect Screening: Aluminum, 18-by-16 mesh, 0.012-inch wire.

2.5 BLANK-OFF PANELS

A. Uninsulated, Blank-Off Panels: Metal sheet attached to back of louver.

1. Aluminum sheet for aluminum louvers, not less than 0.050-inch nominal thickness.
2. Panel Finish: Same finish applied to louvers.
3. Attach blank-off panels with sheet metal screws.
4. Where exposed to view, blank-off panels shall be finished with a black color.

2.6 MATERIALS

A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5, T-52, or T6.

B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Fasteners: Use types and sizes to suit unit installation conditions.

1. Use tamper-resistant screws for exposed fasteners unless otherwise indicated.
2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
3. For color-finished louvers, use fasteners with heads that match color of louvers.

D. Post-Installed Concrete Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency. Special inspection of post-installed concrete anchors shall be in compliance with CBC Table 1705.3 and the evaluation report for the anchor.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.7 FABRICATION

A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.

1. Continuous Vertical Assemblies: Fabricate units without interrupting blade-spacing pattern unless horizontal mullions are indicated.
2. Horizontal Mullions: Provide horizontal mullions at joints unless continuous vertical assemblies are indicated.

C. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

D. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

E. Include supports, anchorages, and accessories required for complete assembly.

F. Provide vertical mullions of type and at spacings indicated, but not more than is recommended by manufacturer, or 72 inches o.c., whichever is less.

1. Fully Recessed Mullions: Where indicated, provide mullions fully recessed behind louver blades. Where length of louver exceeds fabrication and handling limitations, fabricate with close-fitting blade splices designed to permit expansion and contraction.
2. Semirecessed Mullions: Where indicated, provide mullions partly recessed behind louver blades so louver blades appear continuous. Where length of louver exceeds fabrication and handling limitations, fabricate with interlocking split mullions and close-fitting blade splices designed to permit expansion and contraction.

G. Provide subsills made of same material as louvers for recessed louvers.

H. Join frame members to each other and to fixed louver blades with fillet welds concealed from view, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.8 ALUMINUM FINISHES

A. Finish louvers after assembly.

B. High-Performance Organic Finish: Three-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: Custom color to match Architect's sample.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Protect unpainted galvanized and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.

3.4 ERECTION TOLERANCES

A. Erection Tolerances: Install fixed louvers to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
3. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.
4. Alignment:

    a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
    b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
    c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.

3.5 FIELD QUALITY CONTROL (BY OWNER)

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Field and shop welds in compliance with CBC 1705.2.
2. Post-installed concrete anchors in compliance with CBC 1705.3.
3. Exterior cladding in compliance with CBC 1705.12.5.

B. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

D. Fixed louvers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.6 ADJUSTING AND CLEANING

A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

C. Restore louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 089119

SECTION 092116 - GYPSUM BOARD SHAFT WALL ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes gypsum board shaft wall assemblies.

B. Related Requirements:

1. Section 092900 "Gypsum Board" for gypsum board panels and accessories not provided as part of this Section.

1.3 ACTION SUBMITTALS

A. Product Data: For each component of gypsum board shaft wall assembly.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Product Test Reports: For each gypsum board shaft wall assembly, for tests performed by a qualified testing agency. Include fire-resistance rating test data and acoustical test data. Unlisted manufacturers and products will not be accepted.

C. Research/Evaluation Reports: For post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

D. Field quality control reports.

1.5 QUAILITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of gypsum board shaft wall assemblies that have been used for similar applications with successful results, that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports and ICC evaluation reports.

B. Installer Qualifications: A firm with not less than 5 years' experience installing gypsum board shaft wall assemblies similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section. Installer shall also be a member of the Western Wall and Ceiling Contractor's Association.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or with gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Unless using gypsum products that are specifically manufactured for limited exposure, do not install interior products until installations areas are protected from moisture.

C. Do not install panels that are wet, moisture damaged, or mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CertainTeed Corporation.
2. Georgia-Pacific Building Products.
3. National Gypsum Company.
4. PABCO Gypsum.
5. United States Gypsum.

B. Source Limitations: Obtain all gypsum board shaft wall panels (provided under this Section) and gypsum panels provided under Section 092900 “Gypsum Board” from single manufacturer. Do NOT mix-and-match gypsum board panel products that have not been tested together.

2.3 GYPSUM BOARD SHAFT WALL ASSEMBLIES

A. Fire-Resistance Rating: As indicated.

B. STC Rating: As indicated.

C. Gypsum Shaftliner Board:

1. Moisture- and Mold-Resistant Type X: ASTM C 1396; manufacturer's proprietary fire-resistive liner panels with ASTM D 3273 mold-resistance score of 10 as rated according to ASTM D 3274, 1 inch thick, with double beveled long edges.

D. Non-Load-Bearing Steel Framing, General: Complying with ASTM C 645 requirements for metal unless otherwise indicated and complying with requirements for fire-resistance-rated assembly indicated.

1. Protective Coating: Coating with equivalent corrosion resistance of ASTM A 653, G40, unless otherwise indicated.

E. Studs: Manufacturer's standard profile for repetitive, corner, and end members as follows:

1. Depth: As indicated.
2. Minimum Base-Metal Thickness: As indicated, but no less than 0.033 inch.

F. Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least 2 inches long and matching studs in depth.

1. Minimum Base-Metal Thickness: As indicated, but no less than 0.033 inch.

G. Elevator-Hoistway-Entrance Struts: Manufacturer's standard J-profile jamb strut with long-leg length of 3 inches, matching studs in depth, and not less than 0.033 inch thick.

H. Finish Panels: Gypsum board as specified in Section 092900 "Gypsum Board."

I. Batt / Blanket Insulation: As specified in Section 092900 "Gypsum Board."

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with shaft wall manufacturer's written instructions.

B. Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes as specified in Section 092900 "Gypsum Board" that comply with gypsum board shaft wall assembly manufacturer's written instructions for application indicated.

C. Mechanical Fasteners for Cold-Formed Steel Framing Connections: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.

1. Head Type: Low-profile head beneath gypsum panels, manufacturer's standard elsewhere.

D. Steel Drill Screws for Application of Gypsum Board to Cold-Formed Steel Framing: ASTM C 1002 unless otherwise indicated.

E. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.

1. Post-Installed Concrete Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency. Special inspection of post-installed anchors shall be in compliance with the 2016 California Building Code (CBC) Table 1705.3 and the evaluation report for the anchor.
2. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

F. Reinforcing: Galvanized-steel reinforcing strips with 0.033-inch minimum thickness of base metal (uncoated).

G. Perimeter Joints and Penetrations through Gypsum Board Shaft Wall Assemblies: As specified in Section 092900 "Gypsum Board."

H. Gypsum Board Cants:

1. Gypsum Board Panels: As specified in Section 092900 "Gypsum Board," Type X, 5/8-inch panels.
2. Non-Load-Bearing Steel Framing: As specified in Section 092216 "Non-Structural Metal Framing."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Sprayed Fire-Resistive Materials: Coordinate with gypsum board shaft wall assemblies so both elements of Work remain complete and undamaged. Patch or replace sprayed fire-resistive materials removed or damaged during installation of shaft wall assemblies to comply with requirements specified in Section 078100 "Applied Fireproofing."

B. After sprayed fire-resistive materials are applied, remove only to extent necessary for installation of gypsum board shaft wall assemblies and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

3.3 INSTALLATION

A. General: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated, manufacturer's written installation instructions.

B. Do not bridge building expansion joints with shaft wall assemblies; frame both sides of expansion joints with furring and other support.

C. Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, wall-mounted door stops, and similar items that cannot be supported directly by shaft wall assembly framing.

1. Elevator Hoistway: At elevator hoistway-entrance door frames, provide jamb struts on each side of door frame.
2. Reinforcing: Where handrails or other elements directly attach to gypsum board shaft wall assemblies, provide galvanized steel reinforcing strip with 0.054-inch minimum thickness of base metal (uncoated), accurately positioned and secured behind at least one layer of face panel.

D. Penetrations: At penetrations in shaft wall, maintain fire-resistance rating of shaft wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons, elevator floor indicators, and similar items.

E. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels, while maintaining continuity of fire-rated construction.

F. Control Joints: Install control joints in compliance with Section 092900 "Gypsum Board" and according to ASTM C 840 and in specific locations approved by Architect while maintaining fire-resistance rating of gypsum board shaft wall assemblies.

G. Seal gypsum board shaft walls with fire sealant at fire-resistant rated construction and acoustical sealant elsewhere at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly. Install acoustical sealant to withstand dislocation by air-pressure differential between shaft and external spaces; maintain an airtight and smoke-tight seal; and comply with ASTM C 919 requirements or with manufacturer's written instructions, whichever are more stringent.

H. Gypsum Board Cants: In elevator hoistways where gypsum board shaft-wall assemblies cannot be positioned within 4 inches of the shaft face of structural beams, floor edges, and similar projections into shaft, install 5/8-inch- thick, gypsum board cants covering tops of projections. No recesses allowed (at steel beams especially).

1. Slope cant panels at least 75 degrees from horizontal. Set base edge of panels in adhesive and secure top edges to shaft walls at 24 inches o.c. with screws fastened to shaft wall framing.
2. Where steel framing is required to support gypsum board cants, install framing at 24 inches o.c. and extend studs from the projection to shaft wall framing.

I. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Post-installed concrete anchors.

B. Testing agency will report test results promptly and in writing to Contractor and Architect.

C. Remove and replace work where test results indicated that it does not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.5 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, or mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092116

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Interior steel framing systems for interior partitions and furring.
2. Interior suspension systems for supports for ceilings and suspended soffits.
3. Framing accessories, including, but not limited to: supplementary framing, bracing, bridging, solid blocking, backing, kickers, hole-reinforcing plates, backer plates, and custom-formed shapes as indicated or as required to provide suitable framing attachments for substrate materials.

B. Related Requirements:

1. 054000 "Cold-Formed Metal Framing" for exterior cold-formed metal framing and for interior non-structural metal framing not provided as part of this Section.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Product Certificates: For each type of code-compliance certification for studs and tracks.

C. Research/Evaluation Reports: For post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

D. Field quality control reports.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of non-structural metal framing that has been used for similar applications with successful results, that meets or exceeds performance requirements indicated, and of documenting this performance by inclusion in test reports and evaluation reports.

1. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Steel Stud Manufacturers Association.

B. Installer Qualifications: A firm with not less than 10 years' experience installing non-structural metal framing similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section. Installer shall also be a member of the Western Wall and Ceiling Contractor's Association.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 FRAMING SYSTEMS

A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
2. Protective Coating: ASTM A 653, G40, hot-dip galvanized unless otherwise indicated.

B. Studs and Runners: ASTM C 645.

1. Depth: As indicated on Drawings.
2. Minimum Base-Metal Thickness: As indicated on Drawings, but no less than 0.033 inch. "Embossed" steel studs and tracks are not acceptable.

a. For studs supporting cabinets/millwork: As indicated on Drawings, but no less than 0.054 inch.

C. Slip-Type Head Joints:

1. Single Long-Leg Runner System: ASTM C 645 top runner with minimum 2.5-inch-deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
2. Deflection Track: Do NOT use slotted deflection track. Use single long-leg runner system.

D. Pre-Notched Backing Track: For items supported from metal framing.

1. Minimum Base-Metal Thickness: As indicated on Drawings, but no less than 0.054 inch.
2. Depth: As indicated on Drawings.

E. Cold-Rolled Channel Bridging: Steel, 0.054-inch minimum base-metal thickness, with minimum 1/2-inch-wide flanges.

1. Depth: As indicated on Drawings.
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch-thick, galvanized steel.

F. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base-Metal Thickness: As indicated on Drawings, but no less than 0.033 inch.
2. Depth: As indicated on Drawings.

G. Resilient Furring Channels: 1/2-inch-deep, steel sheet members designed to reduce sound transmission.

1. Configuration: Asymmetrical.
2. Basis-of-Design: Cemco, “RC-1.”

H. Cold-Rolled Furring Channels: 0.054-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges.

1. Depth: As indicated on Drawings.

I. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum uncoated-metal thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.

2.3 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A 641, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.

B. Wire Hangers: ASTM A 641, Class 1 zinc coating, soft temper.

1. For Acoustic Panel Ceilings: Refer to Section 095113 "Acoustical Panel Ceilings."
2. For Gypsum Board and Plaster Ceilings/Soffits: Minimum 0.16-inch (#8 gauge) diameter.

C. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.054 inch and minimum 1/2-inch-wide flanges.

1. Depth: As indicated on Drawings.

D. Hat-Shaped, Rigid Furring Channels: ASTM C 645, minimum 0.033-inch bare-steel thickness.

1. Depth: As indicated on Drawings.

E. Steel Studs: ASTM C 645.

1. Minimum Base-Metal Thickness: As indicated on Drawings, but no less that 0.033-inch thickness.
2. Depth: As indicated on Drawings.

2.4 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36, zinc coated by hot-dip process according to ASTM A 123.

B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel hex-headed bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by mechanically deposition according to ASTM B 695, Class 50.

C. Post-Installed Concrete Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency. Special inspection of post-installed concrete anchors shall be in compliance with CBC Table 1705.3 and the evaluation report for the anchor.

D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

1. Power-actuated fasteners shall be in compliance with ASCE 7-10 Section 13.4.5:

a. Power-actuated fasteners in concrete or steel shall not be used for sustained tension loads or for brace applications. Power-actuated fasteners in masonry are not permitted unless approved for seismic loading.

1) Exception: Power-actuated fasteners in concrete used for support of acoustical tile or lay-in panel suspended ceiling applications and distributed systems where the service load on any individual fastener does not exceed 90 lbs.

E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.

1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

2.5 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Provide accessories as indicated, or if not indicated, in size, shape, gauge, and configuration to meet performance requirements:

1. Supplementary framing.
2. Bracing, bridging, and blocking.
3. Anchor clips.
4. End clips.
5. Stud kickers and knee braces.
6. Hole reinforcing plates.
7. Backing plates and pre-notched backing tracks.

C. Isolation Strip at Exterior Walls: Provide one of the following:

1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

D. Drywall Penetration Barrier Mesh: Supply and install Barrier Mesh steel expanded metal panels as a penetration barrier behind gypsum wallboard walls and/or ceilings, as indicated on Drawings.

1. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

a. ClarkDietrich Building Systems; Barrier Mesh for Security.

1) Type: BM10.
2) Material: Carbon steel mesh, complying with ASTM F 1267.
3) Sheet Size: 48 inches by 96 inches.
4) Gauge: 16.
5) Minimum Thickness: 0.048 inches.
6) Diamond: 1 inch.
7) Bond Size, Center-to-Center: 1.00 inches x 2.50 inches.
8) Weight: 41 lbs per 100 square feet.
9) Percent Open Area: 78.

2. The finished shape of the mesh openings shall be a flattened diamond, per ASTM F 1267, Style 2.
3. Barrier Mesh Clips: Barrier Mesh shall be attached to framing members using Barrier Mesh Clips and the appropriate threaded fasteners.

a. For steel framing install a flat head bugle type self-tapping fine thread screw long enough to penetrate the framing member a minimum of 3/8 inch.
b. For wood framing applications install a 1-5/8 inch fine thread drywall screw allowing the fastener to penetrate the framing member at least 1½ inches.
c. In ceiling applications BM-Clips shall be spaced a minimum of (6 or 12) inches along ceiling joists.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

B. Coordination with Sprayed Fire-Resistive Materials:

1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches o.c.
2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that are required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.

1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

C. Backing: Secure pre-notched backing track to studs. Install backing and supplementary framing for support of plumbing fixtures, toilet partitions, wall cabinets, toilet accessories, hardware, opening frames, equipment services, heavy trim, grab bars, furnishings, and similar construction.

D. Install bracing at terminations in assemblies.

E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Single-Layer Application: As indicated.
2. Multilayer Application: As indicated.
3. Tile Backing Panels: 16 inches o.c. unless otherwise indicated.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.

    a. Do NOT use slotted deflection track. Use single long-leg runner system.

2. Bridging: Install horizontal bridging in wall studs, spaced in rows indicated, but not more than 48 inches apart. Fasten at each stud intersection.

    a. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Cold-rolled steel channel, mechanically fastened to webs of punched studs.
    b. Bridging: Cold-rolled steel channel, mechanically fastened to webs of punched studs.

3. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

    a. Install king-post stud at each jamb with a minimum flange of 3-inches unless otherwise indicated.
    b. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

4. Other Framed Openings: Install header and sill section and secure to jamb studs as indicated.
5. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
6. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
7. Curved Partitions:

    a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
    b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches o.c.

8. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

E. Z-Shaped Furring Members:

1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced as indicated on Drawings.
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with screw fasteners spaced at a maximum of 24 inches o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.

F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.5 INSTALLING RESILIENT CHANNELS

A. Walls:

1. Attach single leg resilient channels attachment flange down and at right angles (perpendicular) to studs. Bottom channel (nearest floor) positioned with attachment flange up for ease of attachment. Drive screws through the attachment flange for attachment. Provide screws in accordance with manufacturer's instructions. Nails are not recommended. Fasten channels to studs at each intersection.
2. Locate channels 2" maximum up from floor, within 6" of the ceiling and at no more than 24" intervals. Extend channels into all corners and attach to corner framing. Splice channels directly over studs by nesting (not butting) the channels and driving fastener through both flanges into the support.
3. Screws that are used to attach gypsum board to resilient channel shall only engage the resilient channel and shall not engage any other non-structural metal framing.

B. Ceilings:

1. Attach single leg resilient channels at right angles to ceiling joists/framing. Drive screws through attachment flange for attachment. Provide screws in accordance with manufacturer's instructions. Fasten channels to joists at each intersection. Do not use nails to attach channels to joists. Hold channels away from adjacent walls a minimum of one inch.

3.6 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

    a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

    a. Size supplemental suspension members and hangers to support ceiling loads within deflection limit of L/360.

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Do not attach hangers to steel roof deck.
5. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
6. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
7. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Seismic Bracing: Provide sway-brace suspension systems as indicated on Drawings.

F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

3.7 INSTALLING DRYWALL PENETRATION BARRIER MESH

A. Install drywall penetration barrier mesh in compliance with manufacture's written instructions and as follows:

1. Barrier Mesh (BM) sheets may be installed with diamond running in direction most suitable.
2. BM-Clips shall be installed to secure the mesh to the framing members.
3. Mesh joints occurring on framing members may either join staggered or butt together.
4. It is acceptable to overlap mesh joints to achieve tie-in.
5. BM sheets shall join, begin and terminate on a framing member.
6. BM sheets not joining on framing member shall be wire tied with 18GA steel tie wire. Wire tying shall be no less frequent than the installation of Mesh Clips.

3.8 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Post-installed concrete anchors.

B. Testing agency will report test results promptly and in writing to Contractor, Architect, and Owner.

C. Remove and replace work where test results indicated that it does not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

END OF SECTION 092216

SECTION 092400 - CEMENT PLASTERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes exterior cement plastering system, including, but not limited to, the following:

1. Bond breaker.
2. Lath.
3. Factory-blended base coats, separately cast and cured:

    a. Scratch coat, fiber-reinforced.
    b. Brown coat, fiber-reinforced.

4. Reinforcing mesh and level coat.
5. Primer.
6. Elastomeric textured finish coat.
7. Accessories.
8. System also includes application of sheet air barrier, z-shaped furring, and continuous insulation specified in other Sections.

B. Related Sections:

1. Section 061600 "Sheathing" for glass-mat gypsum sheathing substrates.
2. Section 072100 "Thermal Insulation" for rigid mineral-wool board insulation.
3. Section 072713 "Modified Bituminous Sheet Air Barriers" for sheet air barriers and accessories.

    a. Installer of cement plastering system provided under this Section shall be same installer as for sheet air barriers in order to be eligible for specified special weathertightness warranty.

4. Section 076200 "Sheet Metal Flashing and Trim" for sheet metal flashings to the extent not provided under this Section.
5. Section 079200 "Joint Sealants" for sealants installed with cement plaster.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 SEQUENCING AND SCHEDULING

A. Sequence and schedule installation of cement plastering system with sheet air barrier installation to minimize exposure of weather barrier in accordance with weather barrier manufacturer's written instructions.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product, trim, and accessory.

B. Sustainable Design: For sealants and fluid-applied products, include statement of VOC content.

C. Shop Drawings: Provide project-specific shop drawings showing locations of cement plaster system including plans, elevations, sections, details of components, and attachments to other work.

1. Show locations of all expansion joints and control joints.

D. Samples for Initial Selection: For each type of trim accessory and textured finish indicated.

E. Samples for Verification: For the following products:

1. Trim Accessories: Full-size sample in 12-inch-long length for each trim accessory indicated.
2. Textured Finishes: 12 inch square for each color and texture indicated and on same backing indicated for Work.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Product Test Reports: For components of cement plastering system, for tests performed by manufacturer and witnessed by a qualifying testing agency.

C. Field quality control reports.

D. Sample Warranty: For special warranty.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 20 years' experience regularly engaged in the production and sales of pre-blended exterior cement plaster systems that have been used for similar applications with successful results, that meets or exceeds performance requirements indicated, and of documenting this performance by inclusion in test reports. Manufacturer shall have factory-authorized service representatives who are available for consultation, periodic Project-site observations, and on-site assistance. Manufacturer shall offer 10-year warranty for cement plastering system

B. Installer Qualifications: A firm with not less than 10 years' experience installing exterior cement plaster systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

1. Installer of cement plastering system shall also be same installer as for sheet air barrier system specified in Section 072713 "Modified Bituminous Sheet Air Barriers" in order to be eligible for special weathertightness warranty.

C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build exterior cement plastering mockup as part of overall integrated exterior mockup per Section 014000 "Quality Requirements."
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver all materials in their original sealed containers bearing manufacturer's name and identification of product.

B. Store materials inside under cover, and keep them dry and protected against damage from weather, moisture, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

C. Protect portland cement based materials (bag products) from moisture and humidity. Store under cover off the ground in a dry location.

D. Handle all products as directed on labeling.

1.9 FIELD CONDITIONS

A. Comply with ASTM C 926 requirements and manufacturer's written instructions.

B. Environmental Requirements, General: Comply with requirements of referenced plaster application standards and recommendations of plaster manufacturer for environmental conditions before, during, and after plaster application.

C. Protect construction below cement plaster system from climatic conditions to prevent moisture / weather damage until the installation of cement plaster system.

D. Protect contiguous work from moisture deterioration and soiling that might result from plastering operations. Provide temporary covering and whatever other provisions may be necessary to minimize harmful spattering of plaster on other work.

E. Cold Weather Requirements: Provide heat and protection (temporary or permanent) as required to protect each coat of plaster from freezing for not less than 24 hours after application. Distribute heat uniformly to prevent concentration of heat on plaster near heat sources; provide deflection or protective screens.

1. Exterior Plaster Work: Do not apply plaster when ambient temperature is less than 40°F and falling.

F. Warm Weather Requirements: Protect plaster against uneven and excessive evaporation and from strong flows of dry air, both natural and artificial. Apply and cure plaster as required by climatic and job conditions to prevent dry out during cure period. Provide suitable coverings, moist curing, and barriers to deflect sunlight and wind, or combinations of these, as required.

1. Exterior Plaster Work: Extreme temperatures may require the use of tarps or plastic sheeting to retard evaporation of scratch and brown coats. Do not install cement plastering system if ambient temperatures are expected to rise above 100 deg F within a 24 hour period.

G. Curing Requirements for Exterior Plaster Work: Apply and cure plaster to prevent plaster drying out during curing period. Use procedures required by climatic conditions, including moist curing, providing coverings, and providing barriers to deflect sunlight and wind.

1. Moist cure by lightly fogging in compliance with manufacturer's written instructions, for a duration of not less than 48 hours after installation. Schedule work accordingly to coordinate plaster operations with curing operations during evenings, weekends, and holidays.

H. Factory-Prepared Finishes: Comply with manufacturer's written recommendations for environmental conditions for applying finishes.

1.10 WARRANTY

A. Special Warranty: Cement plaster manufacturer's standard or customized warranty, in which manufacturer agrees to repair or replace components of cement plastering system that do not comply with requirements within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Bond integrity.
b. Deterioration of cement plastering finishes and other cement plastering materials beyond normal weathering.

2. Warranty Period: 10 years from date of Substantial Completion.

B. Special Weathertightness Warranty: Sheet air barrier manufacturer's standard or customized warranty in which sheet air barrier manufacturer and installer of cement plastering system agree to repair or replace components of cement plastering system, including sheet air barriers, flashings, sealants, and associated accessories that do not comply with requirements or that fail to remain air and/or watertight within specified warranty period.

1. Warranty includes removing and reinstalling cement plaster system, air barriers, flashings, accessories, substrates and overburdens.
2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Basis-of-Design Cement Plaster System: Subject to compliance with requirements, provide the following:

1. Parex USA, Inc., Anaheim, CA; "Parex Armourwall 300 HE."

a. See "Plaster Materials" Article below for specific products eligible for manufacturer's 10 year warranty.

2. Or Comparable Equal, subject to compliance with performance and warranty requirements, in addition to compliance with Section 016000 "Product Requirements."

B. Source Limitation: Obtain cement plaster system components and accessories from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance (Cement Plastering): Installed cement plaster system shall withstand exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction.

B. Fire-Resistance Ratings: Where indicated, provide cement plaster assemblies identical to those of assemblies tested for fire resistance according to ASTM E 119 by a qualified testing agency.

C. Fire Propagation Characteristics: Combustible products provided under this Section shall be compliant with listed materials from NFPA-285 test data assemblies as specified in Section 072700 "Sheet Air Barriers."

D. Material Compatibility: Cement plastering system materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by cement plastering manufacturer based on testing and field experience.

E. VOC Emissions: Components of cement plaster system shall have a VOC content of 100 g/L or less.

2.3 BOND BREAKER

A. Building Paper: Water-vapor-permeable, asphalt-saturated kraft building paper that complies with ICC-ES AC38, Grade D.

1. Specified product is NOT to be considered the primary air/weather barrier for the exterior wall assembly. Refer to Section 072700 "Sheet Air Barriers" for primary air/weather barrier.

2.4 LATH

A. Expanded-Metal Lath: ASTM C 847, cold-rolled carbon-steel sheet with ASTM A 653, G60, hot-dip galvanized-zinc coating.

1. Vertical Framing: Diamond-mesh lath, self-furring, 2.5 lb/sq. yd.
2. Horizontal Framing: 3/8-inch rib lath, 3.4 lb/sq. yd.

B. Lath Fasteners and Plates:

1. Corrosion resistant fasteners in conformance with AISI Standard S200-2007 and ASTM C 1513 with minimum three thread penetration beyond steel framing members, and minimum 1-1/4 inch corrosion resistant lath plates, with minimum fastener size and length complying with the following:

a. #8 x 3 inch for 1 inch insulation board thickness.
b. #10 x 3-1/2 inches for 1-1/2 inch insulation board thickness.
c. #10 x 4 inch for 2 inch insulation board thickness.

2. Lath Fastener Spacing: Maximum 6 inches vertically along studs.

2.5 PLASTER MATERIALS

A. Stucco Base Coats:

1. Stucco Scratch Coat: Pre-blended, fiber-reinforced, cement plaster scratch coat material shall be in compliance with ASTM C 926, with a nominal overall thickness of 3/8 inch. Base coat shall be applied separately from brown coat, with appropriate cure time between coats.

a. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

1) Parex USA, Inc.; "Fiber-47 Armourwall Sanded."

2. Stucco Brown Coat: Pre-blended, fiber-reinforced, cement plaster scratch and brown coat material shall be in compliance with ASTM C 926, with a nominal overall thickness of 3/8 inch. Combined thickness of base coat and brown coat shall be minimum 5/8 inch and maximum 7/8 inch. Brown coat shall be applied separately from scratch coat, with appropriate cure time between coats.

a. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

1) Parex USA, Inc.; "Fiber-47 Armourwall Sanded."

B. Leveling and Reinforcing Coat: Copolymer based, factory blend of cement proprietary ingredients requiring addition of water, with minimum 4.5 oz. / sq, yd, reinforcing mesh.

1. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

a. Parex USA, Inc.; "Parex Stucco Level Coat."

C. Primers: A 100-percent acrylic-based, vapor permeable, primer designed to reduce variations in surface absorption, improve finish coverage, and improve consistency of finished aesthetics.

1. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

a. Parex USA, Inc.; Type as recommended by manufacturer suitable for finish coat.

D. Elastomeric Finish Coat: Factory-blended, 100-percent acrylic-polymer based elastomeric textured finish, integrally colored.

1. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

a. Parex USA, Inc.; "Parex E-Lastic Elastomeric Finish."

1) Texture: Per approved sample panels and mockup.

2.6 MISCELLANEOUS MATERIALS

A. Air and Weather Barrier: As specified in Section 072713 "Modified Bituminous Sheet Air Barriers."

B. Z-Shaped Furring: As specified in Section 054000 "Cold-Formed Metal Framing."

C. Continuous Insulation: As specified in Section 072100 "Thermal Insulation."

D. Joint Sealant: As specified in Section 079200 "Joint Sealants."

E. Sand Aggregate: ASTM C 897.

F. Water for Mixing and Finishing Plaster: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.

G. Bonding Compound: ASTM C 932.

H. Fasteners for Attaching Metal Lath to Substrates: ASTM C 1063.

I. Wire: ASTM A 641, Class 1 zinc coating, soft temper, not less than 0.0475-inch diameter unless otherwise indicated.

J. Accessories: Foundation weep screed, casing bead, corner lath in compliance with ASTM C 1063, and fabricated of zinc in compliance with ASTM B 69. All accessories shall have perforated or expanded flanges and shall be designed with grounds for the specified thickness of stucco.

K. Aluminum Trim / Joints: Extruded accessories of profiles and dimensions indicated:

1. Basis-of-Design Joints: Subject to compliance with requirements, provide joints by the following:

a. Fry Reglet Corporation.

2. Aluminum: Alloy and temper with not less that the strength and durability properties of ASTM B 221, Alloy 6063-T5.
3. Finish: Baked-enamel finish, in custom color to match Architect's sample.

2.7 PLASTER MIXES

A. General: Comply with ASTM C 926 for applications indicated.

B. Factory-Prepared Scratch, Brown, and Finish-Coat Mixes: Comply with manufacturer's written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
2. Verify that sheathing surfaces are free for damage, deterioration, and moisture damage.
3. Verify that sheathing, air barriers, and continuous insulation have been installed in accordance with referenced standards, manufacturer's written installation instructions, and have passed all tests and inspections.
4. Report deviations from the requirements of project specifications, manufacturer's written instructions, or other conditions that may adversely affect the cement plastering system installation.

B. Examine roof edges, wall framing, flashings, openings, substrates, and junctures at other construction for suitable conditions where cement plastering will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Begin application only after surfaces are dry.
2. Application of cement plastering system indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Protect contiguous work from moisture deterioration and soiling caused by application of cement plastering. Provide temporary covering and other protection needed to prevent spattering of exterior finish coats on other work.

B. Protect cement plastering substrates, and wall construction behind them from inclement weather during installation. Prevent penetration of moisture behind drainage plane of cement plastering and deterioration of substrates.

C. Prepare and clean substrates to comply with cement plastering manufacturer's written instructions to obtain optimum bond between substrate and cement plastering system.

1. Prepare smooth, solid substrates for plaster according to ASTM C 926.
2. Concrete Substrates: Provide clean, dry, neutral-pH substrate for cement plaster installation. Verify suitability of substrate by performing bond and moisture tests recommended by cement plastering manufacturer.

3.3 INSTALLING AIR AND WEATHER BARRIER

A. Install air and weather barrier as specified in Section 072713 "Modified Bituminous Sheet Air Barriers."

3.4 INSTALLING Z-FURRING SHAPES AND CONTINUOUS INSULATION

A. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 16 inches o.c.

B. Except at exterior corners, securely attach narrow flanges of furring members to wall framing with screws not exceeding 16 inches on center.

C. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of adjacent channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.

3.5 INSTALLING BOND BREAKER

A. Cover exposed exterior surface of continuous insulation with bond breaker securely fastened to framing immediately after continuous insulation is installed.

B. Apply horizontally with a 2-inch overlap and a 6 inch end lap, fastened to framing.

3.6 INSTALLING METAL LATH

A. Metal Lath: Install according to ASTM C 1063 and manufacturer’s written instructions.

3.7 INSTALLING ACCESSORIES

A. Install according to ASTM C 1063 and at locations indicated on Drawings.

B. Reinforcement for External (Outside) Corners:

1. Install lath-type, external-corner reinforcement at exterior locations.

C. Control Joints: Locate as approved by Architect for visual effect and as follows:

1. Provide two piece expansion joints in the stucco system where building movement is anticipated: at joints in the substrate or supporting construction, where the system is to be installed over dissimilar construction or substrates, at changes in building height, at floor lines, at columns and cantilevered areas.
2. Unless otherwise indicated, provide one piece expansion joints every 144 sq. ft. Cut and wire tie lath to the expansion joint accessory so lath is discontinuous at or beneath the accessory. Do not exceed length to width ratio of 2-1/2:1 in expansion joint layout and do not exceed more than 18 feet in any direction without an expansion joint. Where casing bead is used back-to-back as the expansion joint, back the joint with barrier membrane.

    a. Review location of control joints with Architect prior to installation.

3. Provide one piece expansion joints at through wall penetrations, above and below doors and windows.
4. Provide minimum 3/8 inch wide joints where the system abuts windows, doors and other through wall penetrations.
5. Provide appropriate accessories at stucco terminations and joints.
6. Provide appropriate sealant at stucco terminations and at stucco accessory butt joints.

3.8 PLASTER APPLICATION

A. General: Comply with ASTM C 926.

1. Do not deviate more than plus or minus 1/4 inch in 10 feet from a true plane in finished plaster surfaces when measured by a 10-foot straightedge placed on surface.
2. Finish plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground unless otherwise indicated. Where casing bead does not terminate plaster at metal frame, cut base coat free from metal frame before plaster sets and groove finish coat at junctures with metal.
3. Provide plaster surfaces that are ready to receive field-applied finishes indicated.

B. Bonding Compound: Unless otherwise recommended by manufacture, apply on unit masonry and concrete substrates for direct application of plaster.

C. Stucco Base:

1. Scratch Coat:

a. Apply scratch coat to a minimum thickness of 3/8 in, using sufficient trowel pressure to key stucco into lath or to create bond to substrates as applicable.
b. Prior to initial set, scratch horizontally to provide key for bond of brown coat.
c. Moist cure scratch coat with clean potable water for at least 48 hours in accordance with ASTM C926 and the building code following initial application (unless brown coat is applied as soon as the scratch coat has achieved sufficient rigidity to support the brown coat).

2. Brown Coat:

a. Apply brown coat to a minimum thickness of 3/8 in, using sufficient trowel pressure to key stucco into scratch coat.
b. Rod surface to true plane and float to densify.
c. Trowel to smooth and uniform surface to receive acrylic polymer finish coat.
d. Moist cure brown coat with clean potable water for at least 48 hours, in accordance with ASTM C926 and the building codes.

D. Leveling and Reinforcing Coat:

1. After moist curing, allow stucco base to air dry a minimum of 24 hours before applying the leveling and reinforcing coat.
2. Using a stainless steel trowel, apply the stucco leveling coat over the stucco base coat at a thickness of 1/16 to 3/32 in.
3. Fully embed reinforcing mesh into wet leveling coat, including diagonal strips at corners of openings, and trowel smooth. Seam in accordance with manufacturer's written installation instructions.

E. Primer Installation:

1. Remove surface contaminants such as dust or dirt without damaging the substrate.
2. Ambient and surface temperature must be in accordance with manufacturer's written instructions, but no less than 40 deg F during the application and drying time. Supplemental heat and protection from precipitation must be provided as needed.
3. Install primer coat in accordance with manufacturer’s written installation instructions.

F. Elastomeric-Based Finish Coating Installation:

1. Apply finish to stucco that has cured for a duration, with a pH value, in accordance with manufacturer’s written instructions. Apply finish by spraying or troweling with a stainless steel trowel, depending on the specified finish. Follow these general rules for application of finish and manufacturer’s written instructions:

a. Avoid application in direct sunlight.
b. Apply finish in a continuous application, and work a wet edge towards the unfinished wall area. Work to an architectural break in the wall before stopping to avoid cold joints.

c. Weather conditions affect application and drying time. Hot or dry conditions limit working time and accelerate drying. Adjustments in the scheduling of work may be required to achieve desired results; cool or damp conditions extend working time and retard drying and may require added measures of protection against wind, dust, dirt, rain and freezing. Adjust work schedule and provide protection.
d. Do not install separate batches of finish side-by-side.
e. Do not apply finish into or over sealant joints. Apply finish to outside face of wall only.
f. Do not apply finish over irregular or unprepared surfaces, or surfaces not in compliance with the requirements of the project specifications.
g. Do not install finish over high pH (> 10) stucco surfaces or surfaces that have not been fully cured.

2. Apply to provide finish texture and color to match approved sample panels and mockup.

3.9 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Manufacturer's technical representative shall provide technical assistance and guidance for preparation and application of cement plastering system. At a minimum, arrange for manufacturer's technical representative to observe installation of system during mock-up, first 100 square feet of initial installation, at mid-point of the installation, and at completion. Provide additional field observation as required to obtain warranty specified and when requested by Architect or Construction Manager. After each field visit, submit manufacturer's written report of observations within 3 working days. The report shall note overall quality of work, deficiencies, and any other concerns, and recommend corrective action.

B. Final Inspection: Arrange for manufacturer's technical personnel to inspect cement plastering installation upon completion, and as required to obtain manufacturer's warranty.

C. If test results or inspections show cement plaster system does not comply with requirements, remove and replace or repair the cement plaster system as recommended in writing by the manufacturer, and make further repairs after retesting and inspecting until system installation passes. Repair damage to plaster caused by testing; follow manufacturer's written instructions.

D. Cement plastering will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.10 PROTECTION

A. Provide protection of installed materials from water infiltration into or behind them.

B. Provide protection of installed cement plaster from dust, dirt, and precipitation.

C. Protect installed primer and finish from dust, dirt, precipitation, and continuous high humidity until fully dry.

D. Provide sealant and backer material at cement plaster terminations to protect against air, water and insect infiltration. Provide weeps at floor lines, window and door heads, and other areas to conduct water to the exterior.

3.11 PLASTER REPAIRS

A. Repair or replace work to eliminate cracks, dents, blisters, buckles, crazing and check cracking, dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.

3.12 CLEANING

A. Remove temporary protection and enclosure of other work after plastering is complete. Promptly remove plaster from door frames, windows, and other surfaces not indicated to be plastered. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during plastering.

B. Clean and maintain the stucco finish for a fresh appearance and to prevent water entry into and behind the stucco. Repair cracks, impact damage, spalls, and/or delamination promptly.

C. Maintain adjacent components of construction such as sealants, windows, doors, and flashings to prevent water entry into the wall assembly.

END OF SECTION 092400

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Tile backing panels.
3. Cementitious backer units.

B. Related Requirements:

1. Section 054000 "Cold-Formed Metal Framing" for cold-formed metal framing supporting gypsum board assemblies.
2. Section 061600 "Sheathing" for gypsum sheathing for exterior walls.
3. Section 078413 "Penetration Firestopping" and Section 078443 "Joint Firestopping" for sealing and fire-safing perimeters and penetrations through fire-resistant-rated gypsum board assemblies.
4. Section 079200 "Joint Sealants" for sealing perimeters and penetrations through gypsum board assemblies.
5. Section 092116 "Gypsum Board Shaft Wall Assemblies" for metal shaft-wall framing, gypsum shaft liners, and other components of shaft-wall assemblies.
6. Section 092216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: Product data for adhesives and sealants, indicating VOC content.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Product Test Reports: For each fire-resistant-rated and/or acoustic-rated gypsum board wall assembly, for tests performed by a qualified testing agency. Unlisted manufacturers and products will not be accepted.

C. Field quality control reports.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of gypsum board that has been used for similar applications with successful results, that meets or exceeds performance requirements indicated, and of documenting this performance by inclusion in test reports.

B. Installer Qualifications: A firm with not less than 10 years' experience installing gypsum board assemblies similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section. Installer shall also be a member of the Western Wall and Ceiling Contractor's Association.

C. Mockups: Build mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Build mockups for the following:

a. Each level of gypsum board finish indicated for use in exposed locations.
b. Each type of gypsum board indicated for use.

2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
3. Simulate finished lighting conditions for review of mockups.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion

1.6 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.

B. Unless using gypsum products that are specifically manufactured for limited exposure, do not install interior products until installations areas are protected from moisture.

C. Do not install panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency. Do not "mix-and-match" board types within the same wall that have not been tested.

B. STC-Rated Assemblies: For STC-rated assemblies and demising construction around rooms and spaces designated as acoustically air tight ("AT"), provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency. Comply with Section 098100 "Acoustic Insulation and Sealants."

C. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.2 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products by the following:

1. CertainTeed Corporation.
2. Georgia-Pacific Building Products.
3. National Gypsum Company.
4. PABCO Gypsum.
5. United States Gypsum.

B. Source Limitations: Obtain all gypsum board panels (provided under this Section) and gypsum board shaft wall panels provided under Section 092116 “Gypsum Board Shaft Wall Assemblies” from single manufacturer. Do NOT mix-and-match gypsum board panel products that have not been tested together.

2.3 INTERIOR GYPSUM BOARD

A. Gypsum Board, Type X: ASTM C 1396.

1. Thickness: 5/8 inch.
2. Long Edges: Tapered.

B. Gypsum Board, Type C: ASTM C 1396. Manufactured to have increased fire-resistive capability.

1. Thickness: As required by fire-resistance-rated assembly indicated on Drawings.
2. Long Edges: Tapered.

C. Flexible Gypsum Board: ASTM C 1396. Manufactured to bend to fit radii and to be more flexible than standard regular-type gypsum board of same thickness.

1. Thickness: 1/4 and 3/8 inch.
2. Long Edges: Tapered.

D. Glass-Mat Interior Gypsum Board: ASTM C 1658. With fiberglass mat laminated to both sides. Specifically designed for interior use.

1. Core: 5/8 inch, Type X.
2. Long Edges: Tapered.
3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

E. Impact-Resistant Gypsum Board: ASTM C 1396 gypsum board, tested according to ASTM C 1629.

1. Core: Type X.
2. Thickness: 5/8 inch.
3. Surface Abrasion: ASTM C 1629, meets or exceeds Level 3 requirements.
4. Indentation: ASTM C 1629, meets or exceeds Level 1 requirements.
5. Long Edges: Tapered.
6. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.4 EXTERIOR GYPSUM BOARD FOR CEILINGS AND SOFFITS

A. Comply with Section 061600 “Sheathing.”

2.5 TILE BACKING PANELS (OTHER THAN WET AREAS / SURFACES)

A. Glass-Mat, Water-Resistant Backing Board: ASTM C 1178, with manufacturer's standard edges.

1. Core: 5/8 inch, Type X.
2. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.6 CEMENTITIOUS BACKER UNITS (WET AREAS / SURFACES)

A. Cementitious Backer Units: ANSI A118.9 or ASTM C 1325 (Type A), with manufacturer's standard edges.

1. Thickness: 1/2 inch, unless otherwise indicated.
2. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
3. Where used at steam, sauna, showers, and other similar rooms or spaces, cement backer units shall be specifically designated for such use.

2.7 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
2. Shapes:
    a. Cornerbead.
    b. LC-Bead: J-shaped; exposed long flange receives joint compound.
    c. L-Bead: L-shaped; exposed long flange receives joint compound.
    d. U-Bead: J-shaped; exposed short flange does not receive joint compound.
    e. Expansion (control) joint.
    f. Curved-Edge Cornerbead: With notched or flexible flanges.

B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.

1. Subject to compliance with requirements, provide aluminum trim by one of the following:
    a. Fry Reglet Corporation.
    b. Gordon, Inc.
2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221, Alloy 6063-T5.
3. Finish: Factory painted, baked enamel finish.

2.8 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475.

B. Joint Tape: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
    a. Use setting-type compound for installing paper-faced metal trim accessories.
3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.
5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.

D. Joint Compound for Tile Backing Panels:

1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.

E. Joint Compound for Cementitious Backing Units: As recommended by cementitious backer unit manufacturer.

2.9 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
2. Provide hot dipped zinc-coated fasteners complying with ASTM F 2329 in all wet areas.
3. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

C. Mineral-Fiber Insulation [I-4] (For all STC-rated walls, where required in fire tested assemblies, and where indicated): Minimum 2.5 pcf density, consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

1. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

a. Roxul, Inc.; "Safe 'N' Sound."

2. Product shall be GreenGuard certified.

D. Batt / Blanket Insulation [I-5]: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84 and in compliance with Section 720 of the 2016 California Building Code:

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
2. Product shall be GreenGuard certified.

E. Gypsum Board Joint Sealant: As specified in Section 079200 "Joint Sealants."

F. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840 and GA-216.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch-wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. Perimeter Joints and Penetrations Through Gypsum Board Assemblies:

1. At Fire-Resistant Rated Assemblies: Comply with Section 078413 "Penetration Firestopping" and Section 078443 "Joint Firestopping."
2. Elsewhere: Comply with requirements in Section 079299 "Joint Sealants," other Section(s) as applicable, as indicated on Drawings, and with the following:

a. Per Section 2508.1 of the 2016 California Building Code, gypsum board shall be assembled and installed in compliance with ASTM C 840 and GA-216, including, but not limited to, the following:

1) ASTM C 840 paragraph 22.4.4: "All cut-outs shall be back filled with compound used for taping and finishing so that there is no opening larger than 1/4 inch between the gypsum board and the penetrating element."
2) GA-216 paragraph 19.9.1: "All cut edges and openings around pipes and fixtures shall be caulked flush with water-resistant flexible sealant."

J. Install batt / blanket insulation attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Glass-Mat Interior Gypsum Board Type X:

a. Vertical and horizontal surfaces installed prior to completion of building envelope.
b. At wet walls in toilet rooms and other areas not indicated to receive ceramic tile.
c. Interior surface of exterior walls.

2. Impact-Resistant Gypsum Board Type X:

a. At interior exit stairways, and elevator hoistway enclosures, in accordance with “Performance Requirements” article.
b. At vertical surfaces within all corridors, hallways, lobbies, vestibules, atriums, and walls in toilet rooms not receiving tile. At non-fire-rated locations, impact-resistant gypsum board shall be installed from floor level to a height no less than 6-inches above finished ceiling, with Type X board from top of impact resistant board to underside of structure.

3. Flexible Type: Apply in double layer at curved assemblies.
4. Cementitious Backer Board: At shower and other similar wet walls to receive ceramic tile.
5. Glass-Mat, Water-Resistant Backing Board Type X: At walls to receive ceramic tile.
6. Type C: Where required for specific fire-resistance rated assembly indicated.
7. Type X: Vertical and horizontal surfaces unless otherwise indicated.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

    a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
    b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.

3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

D. Curved Surfaces:

1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch-long straight sections at ends of curves and tangent to them.
2. For double-layer construction, fasten base layer to studs with screws 16 inches o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches o.c.

3.4 APPLYING TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer's written installation instructions and install at locations indicated to receive tile. Install with 1/4-inch gap where panels abut other construction or penetrations.

B. Cementitious Backer Units: ANSI A108.11, at shower and other similar wet wall locations indicated to receive tile, as a tile underlayment at wood floors, and where indicated.

C. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners.
2. LC-Bead: Use at exposed panel edges.
3. L-Bead: Use where indicated.
4. U-Bead: Use at exposed panel edges.
5. Curved-Edge Cornerbead: Use at curved openings.

D. Aluminum Trim: Install in locations indicated on Drawings.

3.6 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 2: Ceiling plenum areas, concealed areas, and panels that are substrates for tile.
2. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
    a. Primer and its application to surfaces are specified in other Division 09 Sections.
3. Level 5: Provide at the following locations:
    a. All exposed gypsum board surfaces in spaces open to the public, including, but not limited to the following:
        1) Lobbies.
        2) Gallery.
        3) Public corridors and hallways exceeding 30 feet in length
        4) Walls indicated to receive wall coverings.
        5) Walls indicated to receive a dry erase coating.
        6) Walls indicated to receive a dark paint color.
        7) Where indicated.
    b. Primer and its application to surfaces are specified in other Division 09 Sections.

E. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.

3.7 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 093013 - INTERIOR CERAMIC TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes interior ceramic tiling systems, including, but not limited to, the following:

1. Tile products; includes ceramic, stone, and glass tile.
2. Stone thresholds.
3. Vapor barrier; at showers and where indicated.
4. Shower pan liner; below all showers, whether indicated or not.
5. Waterproof / crack isolation membrane:

    a. Below all tile floors, whether indicated or not.
    b. Below tile walls in all showers, whether indicated or not.

6. Setting materials.
7. Grout materials.
8. Miscellaneous materials and accessories.
9. Testing and application of systems for the reduction of moisture vapor transmission and alkalinity control for interior concrete slabs that are not in compliance with ceramic tile flooring manufacturer’s written requirements.

B. Related Requirements:

1. Section 012100 "Allowances" for moisture vapor emission control allowance.
2. Section 035416 "Hydraulic Cement Underlayment" for self-leveling and patching compound if not provided as part of this Section.
3. Section 079200 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
4. Section 092900 "Gypsum Board" for tile backer board and cementitious backer units.

1.3 DEFINITIONS

A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in its "Specifications for Installation of Ceramic Tile."

C. Module Size: Actual tile size plus joint width indicated.

D. Face Size: Actual tile size, excluding spacer lugs.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: Product data for fluid-applied membranes, setting products, and grouts, indicating VOC content.

C. Shop Drawings: Provide project-specific shop drawings, showing locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

D. Samples for Initial Selection: For tile, grout, and accessories involving color selection.

E. Samples for Verification:

1. Full-size units of each type and composition of tile and for each color and finish required.
2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least 12 inches square, but not fewer than four tiles. Use grout of type and in color or colors approved for completed Work.
3. Full-size units of each type of trim and accessory for each color and finish required.
4. Stone thresholds in 6-inch lengths.
5. Metal edge strips in 6-inch lengths.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturers and installer.

B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

C. Product Certificates: For each type of product.

D. Product Test Reports: For tile-setting and -grouting products.

E. Field Quality Control Reports.

F. Sample Warranty.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications (Ceramic Tile): A firm regularly engaged in producing ceramic tile that has been used for similar applications with successful results, capable of fabricating ceramic tile that meets or exceeds performance requirements indicated, and of documenting this performance by inclusion in test reports.

B. Manufacturer Qualifications (Setting Material, Grout, Waterproof / Crack Isolation Membrane): A firm with not less than 10 years' experience regularly engaged in the production and sales of waterproofing / crack isolation membranes for ceramic tile that have been used for similar applications with successful results, that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports. Manufacturer shall have factory-authorized service representatives who are available for consultation, periodic Project-site observations, and on-site assistance.

C. Installer Qualifications: A firm with not less than 10 years' experience installing ceramic tile systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.. Firm shall also be a five-star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors' Association of America.

D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of minimum 100 square feet of each type of tile installation.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

D. Store liquid materials in unopened containers and protected from freezing.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard or customized form, in which manufacturer and installer agree to repair or replace components of waterproofing systems and/or crack isolation systems that do not comply with requirements or that fails to remain watertight within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Cracked tile as a result of cracking in the substrate material.
b. Inability of the waterproofing membrane to stop the passage of water.

2. Warranty also includes removal and replacement of ceramic tile, setting material, grout, and accessories.
3. Warranty Period: 10 years after date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Tile Products:

1. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide tile products from the following:

a. As indicated on Drawings.

2. Source Limitations for Tile: Obtain tile from single source or producer.

a. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Waterproofing/Crack Control, Setting Materials, Grout:

1. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide products from the following:

a. Laticrete International, Inc.; See Articles below for specific products.

2. Source Limitations for Waterproofing / Crack Isolation, Setting Materials, Grout: Obtain all setting, grouting, and waterproofing / crack isolation materials from single source, from single manufacturer.

2.2 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 (ceramic tile) and ANSI 137.2 (glass tile) for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard grade requirements unless otherwise indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

D. Temporary Protective Coating: Protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.3 TILE PRODUCTS

A. Ceramic Tile:

1. Basis-of-Design Products: As indicated on Drawings.
2. Composition: As indicated on Drawings.
3. Certification: For porcelain tile, certified by the Porcelain Tile Certification Agency.
4. Module Size: As indicated on Drawings.
5. Thickness: As indicated on Drawings.
6. Dynamic Coefficient of Friction for Floor Tile: Not less than 0.42 according to ANSI A137.1.
7. Tile Color and Pattern: As indicated, or if not indicated, as selected by Architect from manufacturer's full range.
8. Grout Color: As indicated, or if not indicated, as selected by Architect from manufacturer’s full range.
9. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as indicated, or if not indicated, as selected from manufacturer's standard shapes.

B. Stone Tile:

1. Basis-of-Design Products: As indicated on Drawings.
2. Stone Types: As indicated on Drawings, complying with the following:

    a. Stone Type: Limestone, complying with ASTM C 568.

3. Abrasion Resistance of Stone Tile for Floors: Not less than 10 according to ASTM C 1353 or ASTM C 241.
4. Dynamic Coefficient of Friction for Floor Tile: Not less than 0.42 according to ANSI A137.1.
5. Provide stone products that are free of defects impairing their function for use indicated, including cracks, seams, and starts.
6. Finish: As indicated on Drawings, or if not indicated, match Architect's sample.
7. Module Size: As indicated on Drawings.
8. Nominal Tile Thickness: As indicated on Drawings.
9. Grout Color: As indicated, or if not indicated, as selected by Architect from manufacturer's full range.
10. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as indicated, or if not indicated, as selected from manufacturer's standard shapes.

C. Glass Tile:

1. Basis-of-Design Products: As indicated on Drawings.
2. Module Size: As indicated on Drawings.
3. Grout Color: As indicated, or if not indicated, as selected by Architect from manufacturer's full range.
4. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as indicated, or if not indicated, as selected from manufacturer's standard shapes.

2.4 STONE THRESHOLDS

A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.

1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/4 inch above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch or less above adjacent floor surface.

B. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of filled plastic resin and complying with ICPA SS-1, except for composition.

1. Basis-of-Design Product: Subject to compliance with requirements, provide quartz agglomerate by the following:

    a. As indicated on Drawings.

2. Colors and Patterns: As indicated on Drawings.

3. Profile: As indicated on Drawings and in compliance with the 2010 ADA Standards for Accessible Design and the accessibility requirements of the 2016 California Building Code.

2.5 VAPOR BARRIER

A. Vapor Barrier: Polyethylene Vapor Retarders: ASTM D 4397, 6-mil-thick sheet, with maximum permeance rating of 0.1 perm.

2.6 SHOWER PAN LINER

A. Shower Pan Liner: Sheet membrane, ASTM D 4068, polyethylene core with a fused non-woven polypropylene exterior surface, IAMPO approved as a shower pan liner.

1. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

a. Laticrete International, Inc.; Laticrete HYDRO BAN Sheet Membrane.

2.7 WATERPROOF AND CRACK ISOLATION MEMBRANE

A. General: Manufacturer's standard product, that complies with both ANSI A118.10, A118.12 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Fluid-Applied Membrane: System consists of a single-component, self-curing, liquid rubber polymer that forms a flexible, seamless waterproofing membrane. Membrane shall provide anti-fracture protection of up to 1/8 inch over shrinkage and other non-structural cracks. Membrane is suitable for direct thin-set installation of ceramic tile and stone directly onto membrane.

1. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

a. Laticrete International, Inc.; Laticrete HYDRO BAN Fluid-Applied Membrane

C. Waterproof and crack isolation membrane shall have a VOC content of 65 g/L or less.

2.8 SETTING MATERIALS

A. Latex-Portland Cement Mortar (Thin Set): Fortified, one-step, thin-set mortar complying with both ANSI A118.4 and A118.15.

1. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

a. Laticrete International, Inc.

1) For glass and transparent tile: Laticrete Glass Tile Adhesive.
2) For opaque tile: Laticrete 254 Platinum.

B. Latex-Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.

1. Reinforcing Wire Fabric: Galvanized, welded-wire fabric, 2 by 2 inches by 0.062-inch diameter; comply with ASTM A 185 and ASTM A 82, except for minimum wire size.
2. Latex Additive: Manufacturer's standard water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed.
3. Where used below shower pan liners, provide minimum 1/4-inch-per-foot slope to drain.
4. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

a. Laticrete International, Inc.; Laticrete 3701 Fortified Mortar Bed.

C. Setting materials shall have a VOC content of 65 g/L or less.

2.9 GROUT MATERIALS

A. Water-Cleanable Epoxy Grout: ANSI A118.3.

1. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

a. Laticrete International, Inc.

B. Color: As indicated, or if not indicated, as selected by Architect from manufacturer’s full range.

C. Grout materials shall have a VOC content of 65 g/L or less.

2.10 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Moisture and Alkalinity Control System: As recommended by flooring manufacturer for mitigation of concrete slabs with moisture emissions and/or alkalinity measurements that are not within flooring manufacturer's written limitations.

C. Waterproof Membrane Accessories: In addition to membrane, provide sealing tape, preformed corners, shapes, and collars for a complete and watertight installation.

D. Temporary Protective Coating: Product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.

1. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile.

E. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

F. Grout Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

1. Manufacturers: Subject to compliance with requirements, provide one of the following:

a. Laticrete International, Inc.

2. Grout sealer materials shall have a VOC content of 65 g/L or less.

2.11 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with manufacturer and installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
2. Verify that concrete substrates for tile floors installed with thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.

a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.

3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
5. Verify that substrates below shower pans are sloped at a minimum of 1/4-inch per foot.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to the ceramic tile and waterproof/crack control membrane manufacturer's written instructions, and with oversight of manufacturer's representative to ensure adhesion of ceramic tile and waterproof/crack control membrane.

B. Concrete Substrates: Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.

1. Mechanically remove, according to manufacturer's written instructions, laitance, glaze, efflorescence, curing compounds, sealers, and hardeners, and other substances that are incompatible with tile-setting materials and that contain soap, wax, oil or silicone, without using solvents.
2. Moisture, Alkalinity, and Bond Testing: Determine the suitability of the concrete subfloor for receiving the waterproof/crack control membrane with regard to moisture content and pH level by moisture and alkalinity tests. Conduct moisture testing in accordance with ASTM F 1869 and ASTM F 2170 unless otherwise recommended by the waterproof/crack control membrane manufacturer. Conduct alkalinity testing as recommended by the manufacturer. Determine the compatibility of the waterproof/crack control membrane to the concrete floors by a bond test in accordance with the manufacturer's recommendations. Submit copy of test reports for moisture and alkalinity content of concrete slab, and bond test, stating date of test, person conducting the test, and the area tested.

    a. Apply moisture and alkalinity control system as recommended by waterproofing manufacturer. Proceed with installation only after substrates pass testing.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

D. Substrate Tolerance for Tile Floors Installed with Thinset Mortar: Where substrate tolerances are not in compliance with ANSI A108.01 for installations indicated, provide a level surface in accordance with ANSI A108.01, manufacturer's written instructions, and the following:

1. Measure surface, grind high spots and protrusions (of concrete, and prior to application of any vapor control system). Fill low spots, so gap at any point between flooring substrate surface and an unleveled, freestanding, straightedge resting on two high spots and place anywhere on the surface does not exceed the following:

    a. Ceramic tile with all edges less than 15 inches:
        1) 1/4 inch in 10 feet, and
        2) 1/16 inch in 12 inches.

    b. Ceramic tile with at least one edge 15 inches in length or longer:
        1) 1/8 inch in 10 feet, and
        2) 1/16 inch in 24 inches.

2. Use compatible trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.

    a. In wet areas with drains, uniformly slope hydraulic cement underlayment toward drains. Flare underlayment to create level surface transition from tile to adjacent flooring material.

E. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

F. Scrape, sand, sweep, and vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

G. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.3 VAPOR BARRIER INSTALLATION

A. Place vapor barrier on side of construction indicated on Drawings.

B. Extend vapor barriers to extremities of areas to protect from vapor transmission. Secure vapor barriers in place with adhesives, vapor barrier fasteners, or other anchorage system as recommended by manufacturer. Extend vapor barriers to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.

C. Seal vertical joints in vapor barriers over framing by lapping no fewer than two studs and sealing with vapor-barrier tape according to vapor-barrier manufacturer's written instructions. Locate all joints over framing members or other solid substrates.

D. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor barriers with vapor-barrier tape to create an airtight seal between penetrating objects and vapor barriers.

E. Repair tears or punctures in vapor barriers immediately before concealment by other work. Cover with vapor-barrier tape or another layer of vapor barriers.

3.4 SHEET SHOWER PAN INSTALLATION

A. Install in accordance with ANSI A 108.01-3.6 and manufacturer’s instructions for installation of sheet membrane waterproofing.

B. Overlap sheets minimum 2 inches shingle fashion in direction of water drainage. Seal joints watertight.

C. In shower receptor waterproofing applications, turn sheet membrane installed on floors up vertical surfaces minimum 3 inches higher than flood plane and mechanically fasten to backing or metal studs.

1. Shower Walls: When sheet membrane is turned up and terminated behind backer board, extend minimum 3 inches above flood plane and fasten to substrate with no penetrations less than 2 inches above flood plane.

D. Extend sheet membrane into floor drains. Cut drain opening in sheet membrane and seal to drain body. Apply a bead of sealant between the membrane and drain body. Secure membrane to floor drain with clamping collar.

E. Seal sheet membrane watertight to items penetrating sheet membrane.

F. Secure liner to backing or studs with nails, screws, or staples in top 1" of flashed membrane.

1. Install upturn at dam over the top and fasten on outside face.
2. Provide fasteners or sealants recommended by manufacturer to suit application.
3. Protect weep holes in drain from clogging using a weep protector or pea gravel.
4. Install mortar bed over the waterproofing membrane per TCNA recommendations.

3.5 WATERPROOF / CRACK ISOLATION MEMBRANE INSTALLATION

A. Install waterproof / crack isolation membrane to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof / crack isolation membrane of uniform thickness that is bonded securely to substrate.

B. Allow waterproof / crack isolation membrane to cure and verify by testing that it is watertight before installing tile or setting materials over it.

3.6 CERAMIC TILE INSTALLATION

A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules and/or for systems as indicated on Drawings. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:

a. Exterior tile floors.
b. Tile floors in wet areas, including, but not limited to, toilet rooms and similar areas.
c. Tile floor consisting of tiles 8 by 8 inches or larger.
d. Tile floors consisting of rib-backed tiles.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

E. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.

F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

1. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
2. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

G. Joint Widths: Unless otherwise indicated, joint widths shall be in accordance with ANSI A108.02 Section 4.3.8, the ceramic tile manufacturer’s written recommendation, and not less than the following:

1. Ceramic Mosaic Tile: 1/8 inch.
2. Glazed Wall Tile: 1/8 inch.
3. Porcelain Tile:

a. With at least one edge 15 inches or longer: 3/8 inch.
b. With all edges less than 15 inches: 1/4 inch

H. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated and where required per ANSI A108.01. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

I. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.

1. Fill joints between such thresholds and adjoining tile set on waterproofing / crack isolation membrane with elastomeric sealant.

J. Grout Sealer: Apply grout sealer according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.7 FIELD QUALITY CONTROL (BY CONTRACTOR)

A. Manufacturer's Field Service: Contractor shall engage a manufacturer's technical representative for technical assistance and guidance for preparation and application of waterproof/crack isolation membrane. At a minimum, arrange for manufacturer's technical representative to observe initial installation of waterproof / crack isolation membrane, at mid-point of the installation, and at completion. Provide additional field observation as required to obtain warranty specified and when requested by Architect or Owner. After each field visit, submit manufacturer's written report of observations within 3 business days. The report shall note overall quality of work, deficiencies, and any other concerns, and recommend corrective action.

B. Final Waterproofing Inspection: Arrange for waterproof / crack isolation membrane manufacturer's personnel to inspect waterproofing installation upon completion of application.

C. Flood Testing: For ceramic tile flooring areas subject to water (shower rooms, toilet rooms, kitchen areas, etc.), flood test each deck area for leaks, according to recommendations in ASTM D 5957, after completing waterproofing but before overlying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.

1. Flood to a maximum depth not exceeding slab slope. Do not wet any adjacent gypsum board.
2. Flood each area for a duration as required per ASTM D 5957 and Testing Agency, but no less than 24 hours.
3. After flood testing, repair leaks, repeat flood tests, and make further repairs until waterproofing installation is watertight.

D. Owner will engage an independent testing agency to observe flood testing and examine underside of decks and terminations for evidence of leaks during flood testing.

E. If test results or inspections show waterproofing / crack isolation membrane does not comply with requirements, remove and replace or repair the waterproofing as recommended in writing by the manufacturer, and make further repairs after retesting and inspecting until waterproofing installation passes.

F. Prepare test and inspection reports.

3.8 ADJUSTING AND CLEANING

A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.

B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.9 PROTECTION

A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.10 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

A. Quality Standard: Unless otherwise indicated, comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules and/or for systems as indicated on Drawings.

1. The Contract Documents may contain requirements that are more stringent than the referenced TCNA quality standard. Comply with the requirements of Contract Documents in addition to those of the referenced quality standard.

B. Interior Floor Installations, Cracked Concrete Subfloor (On-Ground and Above-Ground): TCNA F125-Full-16.

C. Interior Wall Installations, Metal Studs or Furring over Glass-Matt Water-Resistant Gypsum Backer Board (excluding showers): TCNA W248-16.

D. Shower Receptor and Wall Installations (Curbless): TCNA B421C-16.

END OF SECTION 093013

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes acoustical panels and exposed suspension systems for ceilings.

B. Related Requirements:

1. Section 092216 "Non-Structural Metal Framing" for seismic bracing if not included as part of this Section.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.

1. Acoustical Panel: Set of 6-inch-square Samples of each type, color, pattern, and texture.
2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch-long Samples of each type, finish, and color.
3. Clips: Full-size seismic clips.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Ceiling suspension-system members.
2. Structural members to which suspension systems will be attached.
3. Method of attaching hangers to building structure.
4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
5. Items penetrating finished ceiling including the following:

a. Lighting fixtures.
b. Air outlets and inlets.
c. Speakers.
d. Sprinklers.
e. Access panels.
f. Security components.
g. Perimeter moldings.
h. Security components.

6. Perimeter moldings.
7. Show operation of hinged and sliding components adjacent to acoustical panels.

B. Qualification Data: For manufacturer and installer.

C. Product Test Reports: For each acoustical panel ceiling, for tests performed by a qualified testing agency.

D. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor/fastener type, from ICC-ES.

E. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.7 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. Acoustical Ceiling Panels: Full-size panels equal to 2 percent of quantity installed.
2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of acoustic panel ceilings that have been used for similar applications with successful results, that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports Manufacturer shall also have a valid ICC evaluation report for suspension system, including 7/8-inch perimeter metal edge molding for use in seismic design categories D, E, F.

B. Installer Qualifications: A firm with not less than 5 years' experience installing acoustical panel ceilings similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Products: Subject to compliance with requirements, provide products by the following:

1. As indicated on Drawings.

B. Source Limitations: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to the 2016 California Building Code (CBC).

1. Manufacturer shall have a valid ICC evaluation report for suspension system, including 7/8-inch perimeter metal edge molding, for seismic design categories D, E, F.

B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Class A according to ASTM E 1264.
2. Smoke-Developed Index: 50 or less.

C. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL or from the listings of another qualified testing agency.

2.3 ACOUSTICAL PANELS

A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.

B. Performance Characteristics:

1. Classification: Where part of a fire-resistant-rated assembly, provide fire-resistance-rated panels complying with ASTM E 1264.
2. Color: As indicated on Drawings.
3. Edge Joint Detail: As indicated on Drawings.
4. Thickness: Minimum 5/8 inch.
5. Modular Size: As indicated on Drawings.
6. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.
7. Sustainable Design: Acoustical panels made with binder containing no urea formaldehyde.

2.4 METAL SUSPENSION SYSTEM

A. Metal Suspension-System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.

1. High-Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance."

B. Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 coating designation; with prefinished metal caps on flanges.

1. Structural Classification: Heavy-duty system.
2. Profile: As indicated on Drawings.
3. Material: Hot-dipped galvanized steel.
4. Finish: Baked polyester paint or powder coated. Minimum dry film thickness of 1.5 mils. Comply with ASTM C 635 and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
5. Color: As indicated on Drawings, or if not indicated, white.

2.5 ACCESSORIES

A. Attachment Devices: Provide products as indicated on Drawings and as follows:

1. Post-Installed Cast-in-Place Concrete Anchors: Fabricated from corrosion-resistant materials with allowable load or strength design capacities calculated according to ICC ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM C 488 conducted by a qualified testing agency. Special inspection of post-installed concrete anchors shall be in compliance with CBC Table 1705.3 and the evaluation report for the anchor.
2. Power-Actuated Fasteners (PAF): Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

a. PAFs shall NOT be used to anchor diagonal bracing assemblies used to resist seismic loads.

B. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641, Class 1 zinc coating, soft temper.
2. Stainless-Steel Wire: ASTM A 580, Type 304, nonmagnetic.
3. Nickel-Copper-Alloy Wire: ASTM B 164, nickel-copper-alloy UNS No. N04400.
4. Size: As required to meet performance requirements, but not less than 0.106-inch- diameter wire.

C. Hold-Down Clips: Where indicated and/or as required to meet performance requirements, provide manufacturer's standard hold-down clips spaced 24 inches o.c. on all cross tees.

D. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in place.

E. Seismic Separation Joints: Manufacturer's standard seismic separation joints designed to seismically separate adjacent ceiling diaphragms.

F. Clean-Room Gasket System: Where clean-room-type ceilings are indicated, provide manufacturer's standard system, including manufacturer's standard gasket and related adhesives, tapes, seals, and retention clips, designed to seal out foreign material from and maintain positive pressure in clean room.

2.6 METAL EDGE MOLDINGS AND TRIM

A. General: Provide metal edge moldings and trim by same manufacturer as metal suspension system.

B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's 7/8-inch moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.

1. Provide manufacturer's ICC-approved ceiling seismic attachment clip for connecting main and cross runners to edge molding, that fits acoustical panel edge details and suspension system indicated, and that matches width and configuration of exposed runners unless otherwise indicated.
2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

C. Exposed Metal Edge Moldings (At Freestanding Ceiling Edges): Provide exposed members as indicated or required to conceal edges of and penetrations thorough ceiling, to conceal edges of beams, to cover runner webs, for fixture trim and adapters, for fascie at changes in ceiling height, and for other conditions; of metal and finish matching suspended ceiling system.

1. Height: As indicated on Drawings.
2. For circular penetrations of ceiling, fabricate edge moldings to diameter required to fit penetration exactly.

D. Pre-Engineered Perimeter Roller Window Shade Pockets: Manufacturer's pre-engineered and seismically rated perimeter roller window shade pockets designed to receive roller window shades as specified in Section 122413 "Roller Window Shades."

2.7 ACOUSTICAL SEALANT

A. Acoustical Sealant: As specified in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

B. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION

A. General: Install acoustical panel ceilings to comply with ASTM C 636, seismic design requirements indicated, according to the CBC, manufacturer's written instructions, and CISCA's "Ceiling Systems Handbook."

1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
6. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
7. Do not attach hangers to steel deck tabs.
8. Do not attach hangers to steel roof deck. Attach hangers to structural members.
9. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
10. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
11. Light fixtures, ceiling-mounted air terminals, and other ceiling-mounted equipment: Comply with the stricter requirement of the CBC and the manufacturer’s ICC Evaluation Report.

C. If rigid bracing is not indicated, secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with post-installed concrete anchors.

1. PAFs shall NOT be used to anchor diagonal bracing wires used to resist seismic loads

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attach moldings to substrate in compliance with manufacture’s IC report, leveling ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
2. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
3. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
4. For field-fabricated edges and any other field-cut edges exposed to view, finish to match factory edge; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer
5. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions unless otherwise indicated.
6. Install clean-room gasket system in areas indicated, sealing each panel and fixture as recommended by panel manufacturer's written instructions.
7. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

3.4 ERECTION TOLERANCES

A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet, non-cumulative.

B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet, non-cumulative.

3.5 FIELD QUALITY CONTROL (BY OWNER)

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Suspended Ceiling Installation and Anchorage: Comply with periodic special inspection requirements of Section 1705.12.4 of the 2016 California Building Code and with the manufacture’s ICC evaluation report.
2. Installation of post-installed concrete anchors.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.

C. Acoustical panel ceiling hangers and anchors and fasteners will be considered defective if they do not pass tests and inspections.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor’s expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.6 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.

B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

SECTION 095423 - LINEAR METAL CEILINGS (DEFERRED APPROVAL)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes exterior and interior linear metal ceiling system, including, but not limited to, the following:

1. Linear metal ceiling pans.
2. Suspension system.
3. Seismic and wind restraints for suspension system.
4. Sound-absorbent pads.
5. Accessories.

B. Work under this Section is part of a “Deferred Approval.” Coordinate with the deferred approval requirements in Section 013300 “Submittal Procedures” and with the requirements indicated on the Drawings.

C. Related Requirements:

1. Section 054000 "Cold-Formed Metal Framing," Section 055000 "Metal Fabrications," and/or 092216 "Non-Structural Metal Framing" for seismic bracing if not included as part of this Section.
2. Section 095426 "Linear Wood Ceilings" for interior linear wood ceilings.
3. Division 21 Section(s) for sprinkler coordination with ceiling.
4. Division 26 Section(s) for light fixture coordination with ceiling.

1.3 DEFINITIONS

A. CBC: 2016 California Building Code.

B. NRC: Noise Reduction Coefficient.

1.4 COORDINATION

A. Coordinate layout and installation of linear metal pans and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

B. Coordination: Furnish layouts for cast-in-place anchors, clips, and other ceiling anchors whose installation is specified in other Sections.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Provide project-specific shop drawings for linear metal ceiling system, including seismic support details.

1. Shop drawings shall be stamped and signed by the qualified California-licensed professional engineer responsible for their preparation, including calculations, indicating compliance with performance requirements.

C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below:

1. Linear Metal Pan: Set of 12-inch-long Samples of each type and color and a 12-inch-long spliced section.
2. Suspension System Members: 12-inch-long Sample of each type.
3. Exposed Molding and Trim: Set of 12-inch-long Samples of each type, finish, and color.
4. Sound Absorber: 12 inches long.

D. Deferred-Approval Submittal: For linear metal ceiling system indicated to comply with performance requirements and design criteria, including shop drawings, calculations, and analysis data stamped and signed by the qualified California-licensed professional engineer responsible for their preparation.

1.7 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. Linear pattern.
2. Joint pattern.
3. Ceiling suspension members.
4. Method of attaching hangers to building structure.

a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.

5. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, and access panels.
6. Ceiling perimeter and penetrations through ceiling; trim and moldings.

B. Qualification Data: For manufacturer, installer, and professional engineer.

C. Product Test Reports: For each linear metal ceiling, for tests performed by a qualified testing agency.

D. Evaluation Reports: For linear metal ceiling and components and anchor and fastener type, from ICC-ES.

E. Field quality-control reports.

1.8 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.9 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. Linear Metal Ceiling Components: Quantity of each pan, carrier, accessory, and exposed molding and trim equal to 2 percent of quantity installed.

1.10 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of linear metal ceiling systems that have been used for similar applications with successful results, that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports Manufacturer shall also have a current tests reports for linear wood ceiling system indicating system has been tested for use in seismic design categories D, E, F.

B. Installer Qualifications: A firm with not less than 5 years' experience installing linear metal ceiling systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

C. Engineering Responsibility: Prepare data for linear metal ceiling system, including Shop Drawings, based on testing and engineering analysis for manufacturer's standard units in systems similar to those indicated for the Project and submission of reports of tests performed on manufacturer's standard assemblies, stamped and signed by the qualified California-licensed professional engineer responsible for their preparation.

D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Description: First 100 square feet of installation.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Deliver linear metal pans, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they are protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Handle linear metal pans, suspension system components, and accessories carefully to avoid damaging units and finishes in any way.

1.12 PROJECT CONDITIONS

A. Environmental Limitations: Do not install linear metal ceilings until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide products by the following:

1. As indicated on Drawings.

B. Source Limitations: Obtain each type of linear metal ceiling panel and its supporting system from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Deferred Approval Engineering: Engage a qualified California-licensed professional engineer, as defined in Section 014000 "Quality Requirements," to engineer linear metal ceilings, including, but not limited to seismic / wind restraints and attachment devices.

B. Structural Performance: Exterior linear metal ceilings shall withstand exterior exposure and the effects of gravity loads and the following loads and stresses without showing permanent deformation of ceiling system components including pans and suspension system; noise or metal fatigue caused by vibration, deflection, and displacement of ceiling pans; or permanent damage to fasteners and anchors:

1. Wind Load: Uniform pressure as indicated on Drawings, acting inward or outward.
2. Seismic Criteria: Provide linear metal ceilings designed and installed to withstand the effects of earthquake motions according to the following:

a. CBC.
b. Manufacturer shall have independent testing, acceptable to authorities having jurisdiction, confirming linear wood ceiling system has been tested and approved for use in seismic design categories D, E, F.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F material surfaces.

D. Acoustical Performance (Interior Only): Sound absorption NRC of not less than 0.65 according to ASTM C 423.

E. Combustion Characteristics:

1. Exterior: Non-combustible passing ASTM E 136 for combustion characteristics.
2. Interior:

a. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1) Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
2) Smoke-Developed Index: 450 or less.

2.3 LINEAR METAL CEILING PANS

A. Linear Metal Ceiling Characteristics:

1. Metal: Aluminum, with a pan thickness complying with performance requirements and not less than 0.027 inch.
2. Pan Edge Detail: As indicated on Drawings.
3. Linear Module Width and Pan Face Width: As indicated on Drawings.
4. Pan Face Finish: Manufacturer's factory-applied painted finish.

a. Color, Pattern, Texture: As indicated on Drawings.

5. Suspension System Main Carrier Material: Hot dipped galvanized steel.

B. Acoustical Metal Pan Standard: Provide manufacturer's standard linear metal pans of configuration indicated that comply with ASTM E 1264 classifications as designated by types, acoustical ratings, and light reflectances unless otherwise indicated.

1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface per ASTM E 795.

C. Sheet Metal Characteristics: For metal components exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, roughness, stains, or discolorations.

1. Aluminum Sheet: Roll-formed aluminum sheet, complying with ASTM B 209; alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

D. Pan Fabrication: Manufacturer's standard units of size, profile, and edge treatment indicated, formed from metal indicated to snap on and be securely retained on carriers without separate fasteners, and finished to comply with requirements indicated.

E. Pan Splices: Construction same as pans, in lengths 8 to 12 inches; with manufacturer's standard finish.

F. End Caps: Metal matching pans; fabricated to fit and conceal exposed ends of pans.

G. Filler Strips: Metal matching pans; fabricated to uninterruptedly close voids between pans.

H. Moldings and Trim: Provide manufacturer's standard moldings and trim for exposed members, and as indicated or required, for edges and penetrations of ceiling, around fixtures, at changes in ceiling height, and for other conditions; of same metal and finish as linear metal ceiling pans.

I. Sound-Absorbent Pads: Provide width and length to completely fill between carriers, joined at center of panel, with surface-burning characteristics for flame-spread index of 25 or less and smoke-developed index of 50 or less, as determined by testing per ASTM E 84, and to comply with the following requirements:

1. Plastic Sheet-Wrapped Mineral-Fiber Insulation: Pads consisting of nonrigid, PVC plastic sheet encapsulating unfaced mineral-fiber insulation complying with ASTM C 553, Type I, II, or III, and as follows:

a. Mineral-Fiber Type and Thickness: Glass fiber; in thickness required to achieve acoustic performance requirements.
b. Plastic Sheet Thickness and Color: Not less than 0.003 inch; flat black.

2.4 METAL SUSPENSION SYSTEMS

A. Metal Suspension Systems Standard: Provide ceiling manufacturer's standard metal suspension systems of types and finishes indicated that comply with applicable ASTM C 635 requirements.

B. Suspension Systems: Provide systems complete with carriers, splice sections, connector clips, alignment clips, leveling clips, hangers, molding, trim, retention clips, load-resisting struts, fixture adapters, and other suspension components required to support ceiling units and other ceiling-supported construction.

C. Attachment Devices: Comply with the more stringent seismic design requirements of the 2016 California Building Code, manufacturer’s written installation instructions for use in seismic design categories D, E, F, and the following:

1. Post-Installed Concrete Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency. Special inspection of post-installed concrete anchors shall be in compliance with CBC Table 1705.3 and the evaluation report for the anchor
2. Power-Actuated Fasteners (PAF): Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

a. PAFs shall not be used to anchor diagonal brace assemblies used to resist seismic loads.

D. Wire Hangers, Braces, and Ties: Provide wire complying with the following requirements:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641, Class 1 zinc coating, soft temper.
2. Stainless-Steel Wire: ASTM A 580, Type 304, nonmagnetic.
3. Nickel-Copper-Alloy Wire: ASTM B 164, nickel-copper-alloy UNS No. N04400.
4. Size: As required to meet performance requirements, but not less than 0.106-inch- diameter wire.

E. Carriers: Factory finished with matte-black baked finish.

1. Main Carriers: ASTM C 635, heavy duty, steel, not less than 0.0209-inch nominal thickness, cold-rolled sheet, with factory-applied protective coating.

a. Hot-Dip Galvanized Steel: ASTM A 653, not less than G60 zinc coating.

2. Flexible Radial Carriers: Manufacturer's standard radial carriers.
3. Expansion Carriers: Manufacturer's standard carriers allowing for irregularities or other unusual space conditions.
4. Accessories:

a. Special Shapes, Clips, and Components: Provide manufacturer's special shapes, clips, and components to transfer forces in linear carrier members in both directions across linear light fixtures, linear slot diffusers, and other similar conditions.

5. Seismic Separation Joints: Provide manufacturer's standard seismic separation joint system for linear wood ceilings exceeding 2,500 square feet in area. Provide in locations indicated, or if not indicated, in locations as directed by Architect.

F. Carrier Splices: Same metal, profile, and finish as for carriers.

G. Stabilizer Channels, Tees, and Bars: Manufacturer's standard components for stabilizing main carriers at regular intervals and at light fixtures, air-distribution equipment, access doors, and other equipment; spaced as standard with manufacturer for use indicated; and factory finished with matte-black baked finish.

H. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

I. Exterior Bracing: Cold-rolled steel channels and angles, hot-dip galvanized to comply with ASTM A 653, G60 coating designation; size and profile as required to withstand wind load.

J. Hold-Down Clips: Manufacturer's standard hold-down clips spaced as standard with manufacturer.

K. Edge Moldings and Trim: Provide exposed members as indicated or required to comply with seismic requirements of authorities having jurisdiction, to conceal edges of penetrations through ceiling, to conceal ends of pans and carriers, for fixture trim and adapters, for fasciae at changes in ceiling height, and for other conditions; of metal and finish matching linear metal pans or extruded plastic unless otherwise indicated.

1. For Circular Penetrations of Ceiling: Fabricate edge moldings to diameter required to fit penetration exactly.

2.5 ACCESSORIES

A. Access Panels: For access at locations indicated, provide door hinge assembly, retainer clip, and retainer bar, assembled with ceiling panels and carrier sections into access doors of required size, permitting upward or downward opening.

2.6 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. High-Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated and for exterior linear metal ceilings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing and substrates to which linear metal ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of linear metal ceilings.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of linear metal pans to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width pans at borders, and comply with layout shown on reflected ceiling plans and on Coordination Drawings.

3.3 INSTALLATION

A. Comply with ASTM C 636 and seismic requirement indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate to which hangers are attached and for type of hanger involved.
5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that does not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
8. Do not attach hangers to steel deck tabs.
9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
12. Light fixtures, ceiling-mounted air terminals, and other ceiling-mounted equipment: Comply with the stricter requirement of the Building Code and the manufacturer’s ICC Evaluation Report.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers but without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

1. PAFs shall NOT be used to anchor diagonal bracing assemblies used to resist seismic loads.

D. Install edge moldings and trim of type indicated at perimeter of linear metal ceiling area and where necessary to conceal edges and ends of linear metal pans.

1. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
2. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension system carriers so they are aligned and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Cut linear metal pans for accurate fit at borders and at interruptions and penetrations by other work through ceilings. Stiffen edges of cut units as required to eliminate evidence of buckling or variations in flatness exceeding referenced standards for stretcher-leveled metal sheet.

G. Install linear metal pans in coordination with suspension system and exposed moldings and trim.

1. Align joints in adjacent courses to form uniform, straight joints parallel to room axis in both directions unless otherwise indicated.
2. Fit adjoining units to form flush, tight joints. Scribe and cut units for accurate fit at borders and around construction penetrating ceiling.
3. Install pans with butt joints using internal pan splices and in the following joint configuration:

    a. As indicated.

4. Install directionally textured metal pans in directions indicated.
5. Where metal pan ends are visible, install end caps unless trim is indicated.
6. Install filler strips where indicated.
7. Install sound-absorbent pads at right angle to perforated metal pans so pads do not hang unsupported.

H. Install hold-down clips complying with performance requirements.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Suspended ceiling system installation and anchorage: Comply with periodic special inspection requirements of the CBC and manufacturer's evaluation report.
2. Installation of post-installed concrete anchors.

B. Linear metal ceiling hangers and anchors and fasteners will be considered defective if they do not pass tests and inspections.

C. Remove and replace work where test results indicated that it does not comply with specified requirements.

D. Additional testing and inspecting, at Contractor’s expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.5 CLEANING

A. Clean exposed surfaces of linear metal ceilings, including trim and edge moldings after removing strippable, temporary protective covering if any. Comply with manufacturer's written instructions for stripping of temporary protective covering, cleaning, and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage, including dented and bent units.

END OF SECTION 095423

SECTION 095426 - LINEAR WOOD CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes interior linear wood ceiling system, including, but not limited to, the following:

1. Linear wood ceiling members.
2. Suspension system.
3. Seismic restraints for suspension system.
4. Sound-absorbent pads.
5. Accessories.

B. Engineering Responsibility: If manufacturer's linear wood ceiling system is not pre-engineered to meet performance requirements, Contractor’s responsibility includes providing professional engineering services needed to assume engineering responsibility for linear wood ceilings.

C. Related Sections.

1. Section 092216 "Non-Structural Metal Framing" for seismic bracing if not included as part of this Section.
2. Section 095423 "Linear Metal Ceilings" for interior and exterior linear metal ceilings.
3. Division 21 Section(s) for sprinkler coordination with ceiling.
4. Division 23 Section(s) for HVAC work to be coordinated with ceiling.
5. Division 26 Section(s) for light fixture coordination with ceiling.

1.3 DEFINITIONS

A. CBC: 2016 California Building Code.

B. NRC: Noise Reduction Coefficient.

1.4 COORDINATION

A. Coordinate layout and installation of linear metal pans and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

B. Coordination: Furnish layouts for cast-in-place anchors, clips, and other ceiling anchors whose installation is specified in other Sections.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: Product data indicating compliance with sustainable performance requirements.

C. Shop Drawings: Provide project-specific shop drawings for linear wood ceiling system, including seismic support details.

1. If manufacturer's linear wood ceiling system is not pre-engineered to meet performance requirements, shop drawings and analysis data shall be stamped and signed by the qualified California-licensed professional engineer responsible for their preparation.

D. Samples for Verification:

1. Linear Wood Plank: Set of 12-inch-long Samples for each type and color and a 12-inch-long spliced section.
2. Suspension System Members: 12-inch-long Sample of each type.
3. Exposed Molding and Trim: Set of 12-inch-long Samples of each type, finish, and color.
4. Sound Absorber: 12 inches square.

1.7 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Ceiling suspension-system members.
2. Structural members to which suspension systems will be attached.
3. Method of attaching hangers to building structure.
4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
5. Items penetrating finished ceiling including the following:

a. Lighting fixtures.
b. Air outlets and inlets.
c. Speakers.
d. Sprinklers.
e. Access panels.
f. Security components.
g. Perimeter moldings.

B. Qualification Data: For manufacturer and installer.

C. Product Test Reports: For each linear wood ceiling, for tests performed by a qualified testing agency.

D. Evaluation Reports: For each anchor and fastener type, from ICC-ES.

E. Field quality-control reports.

1.8 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.9 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. Linear Wood Ceiling Panels: Full-size panels equal to 1 percent of quantity installed, or 2 boxes, whichever is less.
2. Suspension-System Components: Quantity of each exposed component equal to 1 percent of quantity installed.

1.10 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of linear wood ceilings that have been used for similar applications with successful results, that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports Manufacturer shall also have a current tests reports for linear wood ceiling system indicating system has been tested for use in seismic design categories D, E, F.

1. Engineering Responsibility: If manufacturer's linear wood ceiling system is not pre-engineered to meet performance requirements, Contractor's responsibility includes providing professional engineering services needed to assume engineering responsibility for linear wood ceiling systems.

a. Prepare data for linear wood ceilings, including Shop Drawings and calculations, stamped and signed by the qualified California-licensed professional engineer responsible for their preparation.

B. Installer Qualifications: A firm with not less than 5 years' experience installing linear wood ceilings similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

C. Source Limitations: Obtain each set of linear wood ceilings and suspension systems from one source with resources to provide products of consistent quality in appearance, physical properties, and performance.

D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Mockup Description: First 100 square feet of installation.
2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.11 DELIVERY, STORAGE AND HANDLING

A. Deliver linear wood ceilings, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Do not store in unconditioned spaces with humidity greater than 55 percent or lower than 25 percent relative humidity and temperatures lower than 50 degrees F or greater than 86 degrees F. Panels must not be exposed to extreme temperatures, for example, close to a heating source or near a window with direct sunlight.

C. Before installing linear wood ceiling, permit them to reach room temperature and a stabilized moisture content for a minimum of 72 hours.

D. Handle linear wood ceiling members carefully to avoid chipping edges or damaging units in any way.

1.12 PROJECT CONDITIONS

A. Environmental Limitations: Do not install linear wood ceilings until spaces are enclosed and weatherproof, wet-work in spaces is completed and dry, work above ceilings is complete and ambient temperature and humidity conditions are being maintained at the levels indicated for Project when occupied for its intended use.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide products by the following:

1. As indicated on Drawings.

B. Source Limitations: Obtain each type of linear wood ceiling panel and its supporting suspension system from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Engineering Responsibility: If manufacturer's linear wood ceiling system is not pre-engineered to meet performance requirements, Contractor's responsibility includes engaging a qualified professional engineer, as defined in Section 014000 “Quality Requirements” to design and engineer linear wood ceiling systems to comply with performance requirements.

B. Structural Performance (Interior): Interior linear wood ceilings inside the conditioned building envelope shall withstand the effects of gravity loads and the following loads and stresses without showing permanent deformation of ceiling system components including linear wood members and suspension system; noise or metal fatigues caused by vibration, deflection, and displacement of linear ceiling members; or permanent damage to fasteners and anchors:

1. Seismic Performance: Linear wood ceilings shall withstand the effects of earthquake motions determined according to the following:

a. CBC.
b. Manufacturer shall have independent testing, acceptable to authorities having jurisdiction, confirming linear wood ceiling system has been tested and approved for use in seismic design categories D, E, F.

C. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Class A according to ASTM E 1264.
2. Smoke-Developed: Maximum 450.

D. Acoustical Performance: Sound absorption NRC of not less than 0.65 according to ASTM C 423.

E. Sustainable Design Requirements:

1. Adhesives: Adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers and caulks shall comply with local or regional air pollution control or air quality management district rules where applicable, or SCAQMD Rule 1168 VOC limits, as shown in 2016 CALGreen Tables 5.504.4.1 and 5.504.4.2. Such products also shall comply with the Rule 1168 prohibition on the use of certain toxic compounds (chloroform, ethylene dichloride methylene chloride, perchloroethylene and trichloroethylene). Adhesives shall have no added formaldehyde resins.

a. Adhesives shall have a VOC content of 70 g/L or less

2. Composite Wood Products: Hardwood plywood and medium density fiberboard composite wood products used on the interior or exterior of the building shall meet the requirements for formaldehyde as specified in ARB's Air Toxics Control Measure (ATCM) for Composite Wood (17 CCR 93120 et seq.) Those materials not exempted under the ATCM must meet the specified emission limits, as shown in 2016 CALGreen Table 5.504.4.5.

2.3 LINEAR WOOD CEILING

A. Linear Wood Ceiling Characteristics:

1. Species: As indicated on Drawings.
2. Member Size: As indicated on Drawings.
3. Edge Profile: Square.
4. Members per Linear Foot: As indicated on Drawings.
5. Assembly Style: Cross piece backer.
6. Panel Sizes: As indicated on Drawings.
7. Surface-Burning Characteristics: Class A.
8. Finish: Transparent finish, as indicated on Drawings.
9. Reveal Scrim: Black reveal scrim.

2.4 ACCESSORIES

A. Sound-Absorbent Backing: Provide width and length to completely fill between carriers, with surface-burning characteristics for flame-spread index of 25 or less and smoke-developed index of 50 or less, as determined by testing per ASTM E 84, and to comply with the following requirements:

1. Plastic Sheet-Wrapped Mineral-Fiber Insulation: Pads consisting of nonrigid, PVC plastic sheet encapsulating unfaced mineral-fiber insulation complying with ASTM C 553, Type I, II, or III and as follows:

a. Mineral-Fiber Type: Glass fiber.
b. Acoustical Performance and Thickness: Provide in thickness to meet acoustic performance requirement, but no less than 1/2-inch in thickness.
c. Plastic Sheet Thickness and Color: Not less than 0.003 inch; flat black.

B. Wood Biscuits: For joining and aligning planks end to end.

2.5 METAL SUSPENSION SYSTEM, GENERAL

A. Metal Suspension-System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.

B. Suspension Systems: Provide systems complete with carriers, splice sections, connector clips, alignment clips, leveling clips, hangers, molding, trim, retention clips, load-resisting struts, fixture adapters, and other suspension components required to support ceiling units and other ceiling-supported construction.

C. Attachment Devices: Comply with the more stringent seismic design requirements of the CBC, manufacturer’s written installation instructions for use in seismic design categories D, E, F, and the following:

1. Post-Installed Concrete Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency. Special inspection of post-installed concrete anchors shall be in compliance with CBC Table 1705.3 and the evaluation report for the anchor
2. Power-Actuated Fasteners (PAF): Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

a. PAFs shall NOT be used to anchor diagonal bracing assemblies used to resist seismic loads.

D. Wire Hangers, Braces, and Ties: Provide wires complying with the more stringent of the requirements of the CBC, manufacturer's written installation instructions for seismic design categories D, E, F, and the following:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641, Class 1 zinc coating, soft temper.
2. Nickel-Copper-Alloy Wire: ASTM B 164, nickel-copper-alloy UNS No. N04400.
3. Size: As required to meet performance requirements, but not less than 0.106-inch- diameter wire.

E. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.

F. Seismic Braces: Rigid braces assembled from cold-formed metal framing as indicated on Drawings, and per Section 092216 "Non-Structural Metal Framing."

G. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure linear wood ceiling panels in place.

H. Carriers: Factory finished.

1. Components: All linear carriers shall be commercial quality hot-dipped galvanized steel per ASTM A 653. Linear carriers shall be double-web construction with 15/16 inch type concealed flange design. Exposed surfaces shall be chemically cleansed, capping prefinished galvanized steel in baked polyester paint.

a. Structural Classification: ASTM C 635, Heavy Duty.
b. Color: Black, unless otherwise noted.
c. Clips: Integral, factory-applied, spring steel clips on linear carriers in sufficient number to receive linear wood planks.
d. Accessories:

1) Special Shapes, Clips, and Components: Provide manufacturer's special shapes, clips, and components to transfer forces in linear carrier members in both directions across linear light fixtures, linear slot diffusers, and other similar conditions.

e. Seismic Separation Joints: Provide manufacturer's standard seismic separation joint system for linear wood ceilings exceeding 2,500 square feet in area. Provide in locations indicated, or if not indicated, in locations as directed by Architect.

2.6 ACCESSORIES, EDGE MOLDINGS, AND TRIM

A. Linear Splices: For splicing member together end to end.

B. Clip: Radius clip for creating faceted grid applications.

C. Wall Molding: In compliance with seismic performance requirements.

1. Color: Black.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which linear wood ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of linear wood ceilings.

B. Examine linear wood ceiling panels before installation. Reject wood panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish the layout of linear wood ceiling to balance border widths at opposite edges of each ceiling. Conform to the layout shown on reflected ceiling plans in accordance with linear wood ceiling manufacturer's approved Shop Drawings.

3.3 INSTALLATION

A. General: Install suspension system and linear wood panels in compliance with ASTM C 636, seismic design requirements, and manufacturer's written instructions.

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
8. Do not attach hangers to steel deck tabs.
9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
12. Light fixtures, ceiling-mounted air terminals, and other ceiling-mounted equipment: Comply with the stricter requirement of the Building Code and the manufacturer's ICC Evaluation Report.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors. PAFs shall NOT be used to anchor diagonal bracing wires or rigid braces used to resist seismic loads.

D. Install linear wood panels by mechanically attaching the crosspiece backer into the main runner using screws per manufacturer's written instructions for use in seismic design categories D, E. F.

E. Install wall moldings at intersection of suspended linear wood ceiling and vertical surfaces.

F. Follow manufacturer's written instructions for border treatment and accessories of linear wood ceiling system.

3.4 ERECTION TOLERANCES

A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet, non-cumulative.

B. Linear Wood Ceiling Components: Install linear wood ceiling components level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet, non-cumulative.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Suspended Ceiling Installation and Anchorage: Comply with periodic special inspection requirements of the CBC and with the manufacturer's ICC evaluation report as applicable.
2. Installation of post-installed concrete anchors.

B. Suspension system, seismic bracing system, and anchors will be subject to testing and inspection.

C. Suspension system, hangers and anchors and fasteners will be considered defective if they do not pass tests and inspections.

D. Remove and replace work where test results indicated that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor’s expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.6 CLEANING

A. Clean exposed surfaces of linear wood ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095426

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Resilient base.
2. Resilient molding accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: Product data for adhesives, indicating VOC content.

C. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches long.

D. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.6 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 85 deg F, in spaces to receive resilient products during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer.

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. FloorScore Compliance: Resilient base and accessories shall comply with requirements of FloorScore certification.

B. Adhesives shall have a VOC content of 50 g/L or less.

2.2 MANUFACTURERS

A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide products by the following:

1. As indicated on Drawings.

B. Source Limitations: Obtain resilient base and accessories from single source from single manufacturer.

2.3 RESILIENT BASE

A. Product Standard: ASTM F 1861.

1. Style and Location:

a. Style A, Straight: Provide in areas with carpet.
b. Style B, Cove: Provide in areas with resilient flooring.

B. Minimum Thickness: 0.125 inch.

C. Height: As indicated on Drawings.

D. Lengths: Coils in manufacturer's standard length.

E. Outside Corners: Preformed.

F. Inside Corners: Preformed.

G. Colors: As indicated on Drawings, or if not indicated, as selected by Architect from manufacturer’s full range of colors.

2.4 RESILIENT MOLDING ACCESSORY

A. Description: Resilient cap for cove carpet, cap for cove resilient flooring, carpet bar for tackless installations, carpet edge for glue-down applications, nosing for carpet, nosing for resilient flooring, reducer strip for resilient flooring, joiner for tile and carpet transition strips.

B. Profile and Dimensions: As indicated.

C. Locations: Provide resilient molding accessories in areas indicated, or if not indicated, at flooring transitions of flooring types identified above.

D. Colors and Patterns: As indicated on Drawings, or if not indicated, as selected by Architect from manufacturer’s full range of colors.

2.5 INSTALLATION MATERIALS

A. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

1. Adhesives shall have a VOC content of 50 g/L or less.

B. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of flooring, and in maximum available lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Do not install resilient products until they are the same temperature as the space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.

C. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Preformed Corners: Install preformed corners before installing straight pieces.

3.4 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Perform the following operations immediately after completing resilient-product installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum horizontal surfaces thoroughly.
3. Damp-mop horizontal surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

SECTION 096516 - RESILIENT SHEET FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Resilient sheet flooring.
2. Testing and application of systems for the reduction of moisture vapor transmission and alkalinity control for interior concrete slabs that are not in compliance with resilient sheet flooring manufacturer's written requirements.

B. Related Requirements:

1. Section 012100 "Allowances" for hydraulic cement underlayment allowance and moisture vapor emission control allowance.
2. Section 035416 "Hydraulic Cement Underlayment" for trowelable leveling and patching compound if not provided as part of this Section.
3. Section 096513 "Resilient Base and Accessories" for reducer strips, and other accessories installed with resilient sheet flooring.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to resilient sheet flooring including, but not limited to, the following:

a. Examination and preparation of substrates to receive resilient sheet flooring.
b. Installation.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For resilient flooring products, data indicating compliance with sustainable design performance requirements.

C. Shop Drawings: For each type of resilient sheet flooring.

1. Include sheet flooring layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
2. Show details of special patterns.

D. Samples for Verification: For each type of resilient sheet flooring, in manufacturer's standard size, but not less than 6-by-9-inch sections of each color, texture, and pattern required.

1. For heat-welding bead, manufacturer's standard-size Samples, but not less than 9 inches long, of each color required.

E. Welded-Seam Samples: For seamless-installation technique indicated and for each resilient sheet flooring product, color, and pattern required; with seam running lengthwise and in center of 6-by-9-inch Sample applied to a rigid backing and prepared by Installer for this Project.

F. Product Schedule: For resilient sheet flooring.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of resilient sheet flooring to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Resilient Sheet Flooring: Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, in roll form and in full roll width for each type, color, and pattern of flooring installed.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of resilient sheet flooring that has been used for similar applications with successful results, that meets or exceeds performance requirements indicated, and of documenting this performance by inclusion in test reports. Manufacturer shall have factory-authorized service representatives who are available for consultation, periodic Project-site observations, and on-site assistance.

B. Installer Qualifications: A firm with not less than 5 years' experience installing resilient sheet flooring similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Coordinate mockups in this Section with mockups specified in other Sections.

a. Size: First 100 sq. ft. of installation for each type, color, and pattern in locations directed by Architect.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store resilient sheet flooring and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store rolls upright.

1.10 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 85 deg F, in spaces to receive resilient sheet flooring during the following periods:

1. 72 hours before installation.
2. During installation.
3. 72 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 85 deg F.

C. Close spaces to traffic during resilient sheet flooring installation.

D. Close spaces to traffic for 72 hours after resilient sheet flooring installation.

E. Install resilient sheet flooring after other finishing operations, including painting, have been completed.

1.11 WARRANTY

A. Special Warranty for Resilient Sheet Flooring: Manufacturer's standard or customized form in which Manufacturer and installer agree to repair or replace components of resilient sheet flooring that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, defects/blemishes, scratches/cuts, bubbling/ blistering, cracking/crazing/alligatoring, delamination, resilient sheet "bloom" (yellowing film), failure of heat welded seams, failure to meet manufacturer's minimum published standards for traffic wear and durability.
2. Warranty Period: Ten (10) years from date of Substantial Completion.

B. Special Warranty for Moisture/Alkalinity Control System: Manufacturer's standard or customized form in which Manufacturer and installer agree to repair or replace materials that fail to control water vapor transmission or fail to control alkalinity within specified warranty period.

1. This warranty includes, but is not limited to, the following:

a. Moisture control system.
b. Underlayments.
c. Floor covering system
d. Labor.

2. Warranty Period: Ten (10) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Products: Subject to compliance with requirements, provide resilient sheet flooring by the following:

1. As indicated on Drawings.

B. Source Limitations: Obtain resilient sheet flooring products from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Dynamic Coefficient of Friction: Not less than 0.42 according to ANSI B101.3.

B. Sustainable Design Requirements (CALGreen):

1. At least 80 percent of the total area of resilient tile flooring shall comply with one of the following:

a. Certified under the Resilient Floor Covering Institute FloorScore program.
b. Compliant with the VOC-emission limits and testing requirements specified in the California Department of Public Health's 2010 Standard Method for the Testing and Evaluation Chambers, Version 1.1, February 2010.
c. Compliant with the Collaborative for High Performance Schools California (CA-CHPS) Criteria Interpretation for EQ 7.0 and EQ 7.1 (formerly EQ 2.2) dated July 2012 and listed in the CHPS High Performance Product Database.
d. Products certified under UL GREENGUARD Gold (formerly the Greenguard Children's & Schools Program).

C. Visual Characteristics and Product Options: Information on Drawings and in specifications establishes requirements for aesthetic effects. Aesthetic effects are indicated by colors, patterns, arrangements, alignments and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

2.3 RESILIENT SHEET FLOORING

A. Product Standard: ASTM F 1913, ASTM F 1303, ASTM F 1859, and/or ASTM F 1860 as applicable to the basis-of-design products indicated.

B. Thickness: As indicated on Drawings, or if not indicated, as standard with manufacturer.

C. Wearing Surface: As indicated on Drawings, or if not indicated, smooth subject to compliance with performance requirements.

D. Sheet Width: As standard with manufacturer.

E. Seamless-Installation Method: Heat welded.

F. Colors and Patterns: As indicated on Drawings.

G. Approvals: Approved for food-process environments.

2.4 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient sheet flooring manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by flooring and adhesive manufacturers to suit resilient sheet flooring and substrate conditions indicated.

1. Adhesives shall have a VOC content of 50 g/L or less.

C. Heat-Welding Bead: Manufacturer's solid-strand product for heat welding seams.

1. Colors: Match flooring unless otherwise indicated.

D. Integral-Flash-Cove-Base Accessories:

1. Cove Strip: 1-inch radius provided or approved by resilient sheet flooring manufacturer.
2. Cap Strip: Square metal, vinyl, or rubber cap provided or approved by resilient sheet flooring manufacturer.
3. Corners: Metal inside and outside corners and end stops provided or approved by resilient sheet flooring manufacturer.

E. Floor Polish: Provide protective, liquid floor-polish products recommended by resilient sheet flooring manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer and manufacturer's representative present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion or resilient sheet flooring.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to resilient sheet flooring manufacturer's written instructions, and with oversight by manufacturer’s representative, to ensure adhesion of flooring.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners prior to testing and prior to flooring application.

2. Mechanically remove, according to manufacturer’s written instructions, laitance, glaze, efflorescence, curing compounds, sealers, and hardeners, and other substances that are incompatible with resilient sheet flooring materials and that contain soap, wax, oil or silicone, without using solvents.

3. Moisture, Alkalinity, and Bond Testing: Determine the suitability of the concrete subfloor for receiving the resilient sheet flooring with regard to moisture content and pH level by moisture and alkalinity tests. Conduct moisture testing in accordance with ASTM F 1869 (calcium chloride) and ASTM F 2170 (relative humidity) unless otherwise recommended by the resilient sheet flooring manufacturer. Conduct alkalinity testing as recommended by the resilient sheet flooring manufacturer. Determine the compatibility of the resilient sheet flooring adhesives to the concrete floors by a bond test in accordance with the resilient sheet flooring manufacturer’s recommendations. Submit copy of test reports for moisture and alkalinity content of concrete slab, and bond test, stating date of test, person conducting the test, and the area tested.

a. Apply moisture and alkalinity control system as recommended by resilient sheet flooring manufacturer. Proceed with installation only after substrates pass testing.

C. Substrate Tolerance: Where substrate tolerances are not in compliance with resilient sheet flooring manufacturer's written instructions, produce a level surface in accordance with manufacturer's written instructions and the following:

1. Measure surface, grind high spots, fill low spots, so gap at any point between concrete surface and an unleveled, freestanding, 10-ft-long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/4 inch.
2. Use compatible trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.

D. Do not install resilient sheet flooring until it is same temperature as space where it is to be installed.

1. Move resilient sheet flooring and installation materials into spaces where they will be installed at least 72 hours in advance of installation.

E. Scrape, sand, sweep, and vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 RESILIENT SHEET FLOORING INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient sheet flooring.

B. Unroll resilient sheet flooring and allow it to stabilize before cutting and fitting.

C. Lay out resilient sheet flooring as follows:

1. Maintain uniformity of flooring direction.
2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches away from parallel joints in flooring substrates.
3. Match edges of flooring for color shading at seams.
4. Avoid cross seams.

D. Scribe and cut resilient sheet flooring to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend resilient sheet flooring into toe spaces, door reveals, closets, and similar openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on resilient sheet flooring as marked on substrates. Use chalk or other nonpermanent marking device.

G. Install resilient sheet flooring on covers for telephone and electrical ducts and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of flooring installed on covers and adjoining flooring. Tightly adhere flooring edges to substrates that abut covers and to cover perimeters.

H. Adhere resilient sheet flooring to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

I. Seamless Installation:

1. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and heat weld with welding bead to fuse sections permanently into a seamless flooring installation. Prepare, weld, and finish seams to produce surfaces flush with adjoining flooring surfaces.

J. Integral-Flash-Cove Base: Cove resilient sheet flooring to dimension indicated, but no less than 6 inches, up vertical surfaces. Support flooring at horizontal and vertical junction with cove strip. Butt at top against cap strip.

1. Install metal corners at inside and outside corners.

3.4 FIELD QUALITY CONTROL (BY CONTRACTOR)

A. Manufacturer's Field Services: Engage manufacturer's representative for technical assistance and guidance for surface preparation and installation of resilient sheet flooring system. At a minimum, arrange for manufacturer's representative to observe initial installation (mockup) of resilient sheet flooring system, at midpoint of installation, and at completion. Provide additional field observation as required to obtain specified warranty and when requested by Owner, Architect, or General Contractor. After each field visit, submit manufacturer's written report of observations within 3 business days. The report shall note overall quality of work, deficiencies, and any other concerns, and recommend corrective actions.

B. Field Testing: Engage a qualified testing agency to perform field testing to determine if resilient sheet flooring, including floor polish, complies with specified dynamic coefficient of friction.

1. Field testing is not required if manufacturer provides test reports confirming compliance with performance requirements.

C. If test results or inspections show resilient sheet flooring does not comply with requirements, remove and replace resilient sheet flooring as recommended in writing by manufacturer, and make further repairs after retesting and inspecting until resilient sheet flooring installation passes.

D. Prepare test and inspection reports.

3.5 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient sheet flooring.

B. Perform the following operations immediately after completing resilient sheet flooring installation:

1. Remove adhesive and other blemishes from surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect resilient sheet flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, adhesive, and blemishes from flooring surfaces before applying liquid floor polish.

1. Apply number of coat(s) as recommended by resilient sheet flooring for conditions indicated.
2. Verify that both floor polish and its application method are approved by resilient sheet manufacturer.

E. Cover resilient sheet flooring until Substantial Completion.

END OF SECTION 096516

SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Resilient floor tile.
2. Testing and application of systems for the reduction of moisture vapor transmission and alkalinity control for interior concrete slabs that are not in compliance with resilient flooring manufacturer's written requirements.

B. Related Requirements:

1. Section 012100 "Allowances" for moisture vapor emission control allowance.
2. Section 035416 "Hydraulic Cement Underlayment" for self-leveling hydraulic cement underlayment at concrete floor substrates.
3. Section 096513 "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with resilient flooring.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to resilient flooring including, but not limited to, the following:

a. Examination and preparation of substrates to receive resilient flooring.
b. Installation.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. For resilient flooring products, product data indicating compliance with sustainable design performance requirements.
2. For adhesives, product data indicating VOC content.

C. Shop Drawings: Provide project-specific shop drawings for each type of floor tile.

1. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
2. Show details of special patterns.

D. Samples: Full-size units of each color and pattern of floor tile required.

E. Product Schedule: For floor tile. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency.

C. Field quality control reports.

D. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of resilient tile flooring that has been used for similar applications with successful results, that meets or exceeds performance requirements indicated, and of documenting this performance by inclusion in test reports. Manufacturer shall have factory-authorized service representatives who are available for consultation, periodic Project-site observations, and on-site assistance.

B. Installer Qualifications: A firm with not less than 5 years' experience installing resilient tile flooring similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups for floor tile including resilient base and accessories.

a. Size: First 100 sq. ft. of installation for each type, color, and pattern in locations directed by Architect.

2. Commence installation of mockup in presence of manufacturer's technical representative.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

1.10 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 85 deg F, in spaces to receive floor tile during the following time periods:

1. 7 days before installation.
2. During installation.
3. 7 days after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer.

C. Close spaces to traffic during floor tile installation.

D. Close spaces to traffic for 48 hours after floor tile installation.

E. Install floor tile after other finishing operations, including painting, have been completed.

1.11 WARRANTY

A. Special Warranty for Resilient Flooring: Manufacturer's standard or customized form in which manufacturer and installer agree to repair or replace components of resilient flooring that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, defects/blemishes, scratches/cuts, bubbling/ blistering, cracking/crazing/alligatoring, delamination, failure to meet manufacturer's minimum published standards for traffic wear and durability.
2. Warranty Period: Ten (10) years from date of Substantial Completion.

B. Special Warranty for Moisture/Alkalinity Control System: Manufacturer's standard or customized form in which manufacturer and installer agree to repair or replace materials that fail to control water vapor transmission or fail to control alkalinity within specified warranty period.

1. This warranty includes, but is not limited to, the following:

a. Moisture control system.
b. Underlayments.
c. Floor covering system
d. Labor.

2. Warranty Period: Ten (10) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide resilient tile flooring products by the following:

1. As indicated on Drawings.

B. Source Limitations: Obtain resilient tile flooring from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Dynamic Coefficient of Friction: Not less than 0.42 according to ANSI B101.3.

B. Sustainable Design Requirements:

1. At least 80 percent of the total area of resilient tile flooring shall comply with one of the following:

   a. Certified under the Resilient Floor Covering Institute FloorScore program.
   b. Compliant with the VOC-emission limits and testing requirements specified in the California Department of Public Health's 2010 Standard Method for the Testing and Evaluation Chambers, Version 1.1, February 2010.
   c. Compliant with the Collaborative for High Performance Schools California (CA-CHPS) Criteria Interpretation for EQ 7.0 and EQ 7.1 (formerly EQ 2.2) dated July 2012 and listed in the CHPS High Performance Product Database.
   d. Products certified under UL GREENGUARD Gold (formerly the Greenguard Children's & Schools Program).

2. Adhesives shall have a VOC content of 50 g/L or less.

C. Visual Characteristics and Product Options: Information on Drawings and in specifications establishes requirements for aesthetic effects. Aesthetic effects are indicated by colors, patterns, arrangements, alignments and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

2.3 RESILIENT FLOOR TILE

A. Tile Standard: ASTM F 1700.

B. Thickness: In manufacturer's standard thickness, but not less than 0.125 inch.

C. Size: As indicated on Drawings.

D. Colors and Patterns: As indicated on Drawings, or if not indicated, as selected by Architect from full range of industry colors.

2.4 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.

B. Moisture and Alkalinity Control System: As recommended by resilient flooring manufacturer for mitigation of concrete slabs with moisture emissions and/or alkalinity measurements that are not within resilient flooring manufacturer's written limitations.

C. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

D. Floor Polish: Provide protective, liquid floor-polish products recommended by floor tile manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient tile flooring.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to floor tile manufacturer's written instructions, and with oversight by manufacturer’s representative, to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners prior to testing and prior to flooring application.

2. Mechanically remove, according to manufacturer’s written instructions, laitance, glaze, efflorescence, curing compounds, sealers, and hardeners, and other substances that are incompatible with flooring materials and that contain soap, wax, oil or silicone, without using solvents.

3. Moisture, Alkalinity, and Bond Testing: Determine the suitability of the concrete subfloor for receiving the resilient flooring with regard to moisture content and pH level by moisture and alkalinity tests. Conduct moisture testing in accordance with ASTM F 1869 (calcium chloride) and ASTM F 2170 (relative humidity) unless otherwise recommended by the resilient flooring manufacturer. Conduct alkalinity testing as recommended by the resilient flooring manufacturer. Determine the compatibility of the resilient flooring adhesives to the concrete floors by a bond test in accordance with the resilient flooring manufacturer’s recommendations. Submit copy of test reports for moisture and alkalinity content of concrete slab, and bond test, stating date of test, person conducting the test, and the area tested.

a. Apply moisture and alkalinity control system as recommended by resilient flooring manufacturer. Proceed with installation only after substrates pass testing.

C. Substrate Tolerance: Where substrate tolerances are not in compliance with resilient flooring manufacturer’s written instructions, produce a level surface in accordance with manufacturer’s written instructions and the following:

1. Measure surface, grind high spots (of concrete, and prior to application of any vapor control system), fill low spots, so gap at any point between floor substrate surface and an unleveled, freestanding, 10-ft-long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.
2. Use compatible trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.

D. Do not install floor tiles until they are the same temperature as the space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.

E. Immediately before installation, scrape, sand, sweep, and vacuum clean substrates to be covered. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles in pattern indicated, or if not indicated, square with room axis.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.

G. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 FIELD QUALITY CONTROL (BY CONTRACTOR)

A. Manufacturer’s Field Services: Engage manufacturer’s representative for technical assistance and guidance for surface preparation and installation of resilient tile flooring system. At a minimum, arrange for manufacturer’s representative to observe initial installation (mockup) of resilient flooring system, at midpoint of installation, and at completion. Provide additional field observation as required to obtain specified warranty and when requested by Owner, Architect, or General Contractor. After each field visit, submit manufacturer’s written report of observations within 3 business days. The report shall note overall quality of work, deficiencies, and any other concerns, and recommend corrective actions.

B. Field Testing: Engage a qualified testing agency to perform field testing to determine if polished resilient tile flooring complies with specified dynamic coefficient of friction.

1. Field testing is not required if manufacturer provides test data conducted with the last three years that installed resilient tile flooring product meets performance requirements indicated.

C. If test results or inspections show resilient tile flooring does not comply with requirements, remove and replace polish and/or replace the resilient tile flooring as recommended in writing by manufacturer, and make further repairs after retesting and inspecting until resilient tile flooring installation passes.

D. Prepare test and inspection reports.

3.5 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.

B. Perform the following operations immediately after completing floor tile installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.

1. Apply number of coat(s) as recommended by manufacturer of resilient tile flooring for conditions indicated.
2. Verify that both floor polish and its application method are approved by manufacturer.

E. Cover floor tile until Substantial Completion.

END OF SECTION 096519

SECTION 096536 - STATIC-CONTROL RESILIENT FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Static-conductive, solid vinyl floor tile.
2. Testing and application of systems for the reduction of moisture vapor transmission and alkalinity control for interior concrete slabs that are not in compliance with resilient flooring manufacturer's written requirements.

B. Related Requirements:

1. Section 012100 "Allowances" for moisture vapor emission control allowance.
2. Section 035416 "Hydraulic Cement Underlayment" for trowelable leveling and patching compound if not provided as part of this Section.
3. Section 096513 "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with static-control resilient flooring.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to static-control resilient flooring including, but not limited to, the following:

a. Examination and preparation of substrates to receive static-control resilient flooring.
b. Installation.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. For resilient flooring products, product data indicating compliance with sustainable design performance requirements.
2. For adhesives, product data indicating VOC content.

C. Shop Drawings: For each type of static-control resilient flooring. Include floor-covering layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.

1. Show details of special patterns.
2. Submit grounding diagram showing location of grounding strips and connections.

D. Samples: Full-size units of each color and pattern of static-control floor tile required.

E. Product Schedule: For static-control resilient flooring. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for static-control resilient flooring.

C. Field quality control reports.

D. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of static-control resilient flooring to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of static-control resilient flooring that has been used for similar applications with successful results, that meets or exceeds performance requirements indicated, and of documenting this performance by inclusion in test reports. Manufacturer shall have factory-authorized service representatives who are available for consultation, periodic Project-site observations, and on-site assistance.

B. Installer Qualifications: A firm with not less than 5 years' experience installing static-control resilient flooring similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups for static-control resilient flooring including resilient base and accessories.

a. Size: First 100 sq. ft. of installation for each type, color, and pattern in locations directed by Architect.

2. Commence installation of mockup in presence of manufacturer's technical representative.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store static-control resilient flooring and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

1.10 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 85 deg F, in spaces to receive static-control resilient flooring during the following time periods:

1. 7 days before installation.
2. During installation.
3. 7 days after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer.

C. Close spaces to traffic during static-control resilient flooring installation.

D. Close spaces to traffic for 48 hours after static-control resilient flooring installation.

E. Install static-control resilient flooring after other finishing operations, including painting, have been completed.

1.11 WARRANTY

A. Special Warranty for Resilient Flooring: Manufacturer's standard or customized form in which Manufacturer agrees to repair or replace components of static-control resilient flooring that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, defects/blemishes, scratches/cuts, bubbling/ blistering, cracking/crazing/alligatoring, delamination, failure to meet manufacturer's minimum published standards for traffic wear and durability.
2. Warranty Period:

a. Electrical Resistance: Lifetime warranty.
b. Wear-Through: 25 years from date of Substantial Completion.
c. Defects in Workmanship and Materials: 75 years from date of Substantial Completion.

B. Special Warranty for Moisture/Alkalinity Control System: Manufacturer's standard or customized form in which Manufacturer agrees to repair or replace materials that fail to control water vapor transmission or fail to control alkalinity within specified warranty period.

1. This warranty includes, but is not limited to, the following:

a. Moisture control system.
b. Underlayments.
c. Floor covering system
d. Labor.

2. Warranty Period: Ten (10) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide static-control resilient flooring products by the following:

1. As indicated on Drawings.

B. Source Limitations: Obtain static-control resilient tile flooring from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Conductive Properties: Provide static-control resilient flooring with static-control properties indicated as determined by testing identical products per test method indicated by an independent testing and inspecting agency.

1. Electrical Resistance: Test per ASTM F 150 and ESD-STM-7.1.

a. Average greater than 25,000 ohms and less than 1 megohm when test specimens and installed floor coverings are tested surface to surface (point to point).
b. Average greater than 25,000 ohms with no single measurement less than 10,000 ohms when installed floor coverings are tested surface to ground.

2. Static Generation: Less than 12 V when tested per AATCC-134 at 20 percent relative humidity with conductive footwear.
3. Static Decay: 5000 to zero V in less than 0.01 seconds when tested per ASTM E-101C.

B. Dynamic Coefficient of Friction: Not less than 0.42 in accordance with ANSI B101.3.

C. Sustainable Design Requirements:

1. At least 80 percent of the total area of resilient tile flooring shall comply with one of the following:

a. Certified under the Resilient Floor Covering Institute FloorScore program.
b. Compliant with the VOC-emission limits and testing requirements specified in the California Department of Public Health's 2010 Standard Method for the Testing and Evaluation Chambers, Version 1.1, February 2010.
c. Compliant with the Collaborative for High Performance Schools California (CA-CHPS) Criteria Interpretation for EQ 7.0 and EQ 7.1 (formerly EQ 2.2) dated July 2012 and listed in the CHPS High Performance Product Database.
d. Products certified under UL GREENGUARD Gold (formerly the Greenguard Children's & Schools Program).

2. Adhesives shall have a VOC content of 50 g/L or less.

D. Visual Characteristics and Product Options: Information on Drawings and in specifications establishes requirements for aesthetic effects. Aesthetic effects are indicated by colors, patterns, arrangements, alignments and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

2.3 STATIC CONDUCTIVE RESILIENT FLOOR COVERINGS

A. Tile Standard: ASTM F 1700.

B. Thickness: In manufacturer’s standard thickness, but not less than 0.125 inch.

C. Size: As indicated on Drawings.

D. Colors and Patterns: As indicated on Drawings.

2.4 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified portland cement or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Moisture and Alkalinity Control System: As recommended by resilient flooring manufacturer for mitigation of concrete slabs with moisture emissions and/or alkalinity measurements that are not within resilient flooring manufacturer’s written limitations.

C. Static-Control Adhesive: Provided or approved by manufacturer; type that maintains electrical continuity of floor-covering system to ground connection.

D. Grounding Strips: Provided or approved by manufacturer; type and size that maintains electrical continuity of floor-covering system to ground connection.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer and manufacturer's representative present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion or static-control characteristics of floor coverings.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions and with oversight by manufacturer's representative to ensure adhesion of static-control resilient flooring and electrical continuity of floor-covering systems.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners prior to testing and prior to flooring application.

2. Mechanically remove, according to manufacturer’s written instructions, laitance, glaze, efflorescence, curing compounds, sealers, and hardeners, and other substances that are incompatible with wood flooring materials and that contain soap, wax, oil or silicone, without using solvents.

3. Moisture, Alkalinity, and Bond Testing: Determine the suitability of the concrete subfloor for receiving the resilient flooring with regard to moisture content and pH level by moisture and alkalinity tests. Conduct moisture testing in accordance with ASTM F 1869 (calcium chloride) and ASTM F 2170 (relative humidity) unless otherwise recommended by the resilient flooring manufacturer. Conduct alkalinity testing as recommended by the resilient flooring manufacturer. Determine the compatibility of the resilient flooring adhesives to the concrete floors by a bond test in accordance with the resilient flooring manufacturer's recommendations. Submit copy of test reports for moisture and alkalinity content of concrete slab, and bond test, stating date of test, person conducting the test, and the area tested.

   a. Apply moisture and alkalinity control system as recommended by resilient flooring manufacturer. Proceed with installation only after substrates pass testing.

C. Substrate Tolerance: Where substrate tolerances are not in compliance with resilient flooring manufacturer's written instructions, produce a level surface in accordance with manufacturer's written instructions and the following:

1. Measure surface, grind high spots (of concrete, and prior to application of any vapor control system), fill low spots, so gap at any point between floor substrate surface and an unleveled, freestanding, 10-ft-long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.
2. Use compatible trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.

D. Do not install static-control resilient flooring until it is same temperature as space where it is to be installed.

1. Move static-control resilient flooring and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

E. Immediately before installation, scrape, sand, sweep, and vacuum clean substrates to be covered. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION, GENERAL

A. Install static-control resilient flooring according to manufacturer's written instructions and with oversight by manufacturer's representative.

B. Embed grounding strips in static-control adhesive. Extend grounding strips beyond perimeter of static-control resilient floor-covering surfaces to ground connections.

C. Scribe, cut, and fit static-control resilient flooring to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

D. Extend static-control resilient flooring into toe spaces, door reveals, closets, and similar openings. Extend static-control resilient flooring to center of door openings.

E. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on static-control resilient flooring as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

F. Adhere static-control resilient flooring to substrates using a full spread of static-control adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 FLOOR-TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so floor tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half floor tile at perimeter.

1. Lay floor tiles in pattern indicated, or if not indicated, square with room axis.

C. Match floor tiles for color and pattern by selecting floor tiles from cartons in same sequence as manufactured and packaged if so numbered. Discard broken, cracked, chipped, or deformed floor tiles.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.5 FIELD QUALITY CONTROL (BY CONTRACTOR)

A. Manufacturer’s Field Services: Engage manufacturer’s representative for technical assistance and guidance for surface preparation and installation of resilient tile flooring system. At a minimum, arrange for manufacturer’s representative to observe initial installation (mockup) of resilient flooring system, at midpoint of installation, and at completion. Provide additional field observation as required to obtain specified warranty and when requested by Owner, Architect, or General Contractor. After each field visit, submit manufacturer’s written report of observations within 3 business days. The report shall note overall quality of work, deficiencies, and any other concerns, and recommend corrective actions.

B. Field Testing: Engage a qualified testing agency to perform field testing to determine if static-control resilient tile flooring complies with specified dynamic coefficient of friction.

1. Field testing is not required if manufacturer provides test data conducted with the last three years that installed resilient tile flooring product meets performance requirements indicated.

C. If test results or inspections show static-control resilient flooring does not comply with requirements, remove and replace the static-control resilient flooring as recommended in writing by manufacturer, and make further repairs after retesting and inspecting until static-control resilient flooring installation passes.

D. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of static-control resilient flooring.

B. Perform the following operations immediately after completing static-control resilient flooring:

1. Remove static-control adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect static-control resilient flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

1. Do not wax static-control resilient flooring.
2. If recommended in writing by manufacturer, apply protective static-control floor polish formulated to maintain or enhance floor covering's electrical properties; ensure static-control resilient flooring surfaces are free from soil, static-control adhesive, and surface blemishes.

    a. Verify that both floor polish and its application method are approved by manufacturer and that floor polish will not leave an insulating film that reduces static-control resilient flooring's effectiveness for static control.

D. Cover static-control resilient flooring until Substantial Completion.

END OF SECTION 096536

SECTION 096566 - RESILIENT ATHLETIC FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Resilient rubber athletic flooring system.
2. Testing and application of systems for the reduction of moisture vapor transmission and alkalinity control for interior concrete slabs that are not in compliance with resilient athletic flooring manufacturer's written requirements.

B. Related Requirements:

1. Section 012100 "Allowances" for hydraulic cement underlayment and moisture vapor emission control allowances.
2. Section 035416 "Hydraulic Cement Underlayment" for trowelable leveling and patching compound if not provided as part of this Section.
3. Section 096513 "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with resilient flooring.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to resilient athletic flooring including, but not limited to, the following:

a. Examination and preparation of substrates to receive resilient flooring.
b. Installation.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. For adhesives, product data indicating VOC content.
2. For resilient athletic flooring products, product data indicating compliance with sustainable design performance requirements.

C. Shop Drawings: Provide project-specific shop drawings for each type of resilient athletic flooring.

1. Show installation details and floor patterns.

D. Samples for Verification: For each type, color, and pattern of flooring specified, 6-inch- square in size and of same thickness and material indicated for the Work.

1. Seam Samples: For each sheet flooring color and pattern required; with seam running lengthwise and in center of 6-by-9-inch Sample applied to a rigid backing and prepared by Installer for this Project.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency.

C. Field quality control reports.

D. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For resilient athletic flooring to include in maintenance manuals.

1.7 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. Sheet Flooring: Furnish amount approximately 2 percent of the total floor surface, of each type, color and dye lot.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of resilient athletic flooring that has been used for similar applications with successful results, that meets or exceeds performance requirements indicated, and of documenting this performance by inclusion in test reports. Manufacturer shall have factory-authorized service representatives who are available for consultation, periodic Project-site observations, and on-site assistance.

B. Installer Qualifications: A firm with not less than 5 years' experience installing resilient athletic flooring similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups for resilient athletic flooring, including accessories.

a. Size: Minimum 100 sq. ft. for each type, color, and pattern in locations directed by Architect.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storing.

B. Store materials to prevent deterioration.

C. Avoid storing materials for extended periods of time.

1.10 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 85 deg F, in spaces to receive floor tile during the following time periods:

1. 7 days before installation.
2. During installation.
3. 7 days after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer.

C. Close spaces to traffic during floor tile installation.

D. Close spaces to traffic for 48 hours after floor tile installation.

E. Install floor tile after other finishing operations, including painting, have been completed.

1.11 WARRANTY

A. Special Warranty for Moisture/Alkalinity Control System: Manufacturer's standard or customized form in which manufacturer and installer agree to repair or replace materials that fail to control water vapor transmission or fail to control alkalinity within specified warranty period.

1. This warranty includes, but is not limited to, the following:

a. Moisture control system.
b. Underlayments.
c. Floor covering system
d. Labor.

2. Warranty Period: Ten (10) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide resilient athletic flooring products by the following:

1. As indicated on Drawings.

B. Source Limitations: Obtain resilient tile flooring from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Dynamic Coefficient of Friction: Not less than 0.42 according to ANSI B101.3.

B. Sustainable Design Requirements:

1. At least 80 percent of the total area of resilient tile flooring shall comply with one of the following:

a. Certified under the Resilient Floor Covering Institute FloorScore program.

b. Compliant with the VOC-emission limits and testing requirements specified in the California Department of Public Health's 2010 Standard Method for the Testing and Evaluation Chambers, Version 1.1, February 2010.
c. Compliant with the Collaborative for High Performance Schools California (CA-CHPS) Criteria Interpretation for EQ 7.0 and EQ 7.1 (formerly EQ 2.2) dated July 2012 and listed in the CHPS High Performance Product Database.
d. Products certified under UL GREENGUARD Gold (formerly the Greenguard Children's & Schools Program).

2. Adhesives shall have a VOC content of 50 g/L or less.

C. Visual Characteristics and Product Options: Information on Drawings and in specifications establishes requirements for aesthetic effects. Aesthetic effects are indicated by colors, patterns, arrangements, alignments and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

2.3 RUBBER SHEET FLOORING

A. Description: Prefabricated resilient rubber athletic flooring, calendered and vulcanized with a base of natural and synthetic rubbers, stabilizing agents and pigmentation, provided as sheet goods for adhered installation.

B. Material: Rubber wear layer and rubber shock-absorbent layer, vulcanized together.

C. Traffic-Surface Texture: Hammered.

D. Sheet Size: Manufacturer's standard width by longest length that is practical to minimize splicing during installation.

E. Thickness: Not less than 10 mm.

F. Color and Pattern: As indicated on Drawings, or if not indicated, as selected by Architect from manufacturer's full range.

G. Border: Same material as sheet flooring; with bevels that transition from thickness of sheet flooring to surface below it; with straight outside edges; for use where flooring corners and edges do not abut vertical surfaces.

1. Border Color and Pattern: As indicated on Drawings, or if not indicated, as selected by Architect from manufacturer's full range.

2.4 ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated

B. Moisture and Alkalinity Control System: As recommended by resilient flooring manufacturer for mitigation of concrete slabs with moisture emissions and/or alkalinity measurements that are not within resilient flooring manufacturer's written limitations.

C. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions, and with oversight by manufacturer's representative, to ensure adhesion of flooring.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners prior to testing and prior to flooring application.

2. Mechanically remove, according to manufacturer's written instructions, laitance, glaze, efflorescence, curing compounds, sealers, and hardeners, and other substances that are incompatible with wood flooring materials and that contain soap, wax, oil or silicone, without using solvents.

3. Moisture, Alkalinity, and Bond Testing: Determine the suitability of the concrete subfloor for receiving the resilient athletic flooring with regard to moisture content and pH level by moisture and alkalinity tests. Conduct moisture testing in accordance with ASTM F 1869 (calcium chloride) and ASTM F 2170 (relative humidity) unless otherwise recommended by the resilient athletic flooring manufacturer. Conduct alkalinity testing as recommended by the resilient athletic flooring manufacturer. Determine the compatibility of the resilient athletic flooring adhesives to the concrete floors by a bond test in accordance with the resilient athletic flooring manufacturer's recommendations. Submit copy of test reports for moisture and alkalinity content of concrete slab, and bond test, stating date of test, person conducting the test, and the area tested.

a. Apply moisture and alkalinity control system as recommended by resilient athletic flooring manufacturer. Proceed with installation only after substrates pass testing.

C. Substrate Tolerance: Where substrate tolerances are not in compliance with resilient flooring manufacturer's written instructions, produce a level surface in accordance with manufacturer's written instructions and the following:

1. Measure surface, grind high spots, fill low spots, so gap at any point between concrete surface and an unleveled, freestanding, 10-ft-long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.
2. Use compatible trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.

D. Do not install resilient athletic flooring until it is at the same temperature as the space where it is to be installed.

1. At least 48 hours in advance of installation, move resilient athletic flooring and installation materials into spaces where they will be installed.

E. Immediately before installation, scrape, sand, sweep, and vacuum clean substrates to be covered. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 FLOORING INSTALLATION, GENERAL

A. Comply with manufacturer's written installation instructions.

B. Scribe, cut, and fit flooring to butt neatly and tightly to vertical surfaces, equipment anchors, floor outlets, and other interruptions of floor surface.

C. Extend flooring into toe spaces, door reveals, closets, and similar openings unless otherwise indicated.

D. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating subfloor markings on flooring. Use nonpermanent, nonstaining marking device.

3.4 SHEET FLOORING INSTALLATION

A. Allow sheet flooring to stabilize before cutting and fitting.

B. Lay out sheet flooring as follows:

1. Maintain uniformity of flooring direction.
2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches away from parallel joints in flooring substrates.
3. Match edges of flooring for color shading at seams.
4. Locate seams according to approved Shop Drawings.

C. Adhere products to substrates using a full spread of adhesive applied to substrate to comply with adhesive and flooring manufacturers' written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.

1. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
2. Seam in accordance with manufacturer’s written installation instructions.

3.5 FIELD QUALITY CONTROL

A. Manufacturer’s Field Services: Engage manufacturer’s representative for technical assistance and guidance for surface preparation and installation of resilient athletic flooring system. At a minimum, arrange for manufacturer’s representative to observe initial installation of resilient flooring system, at midpoint of installation, and at completion. Provide additional field observation as required to obtain specified warranty and when requested by Owner, Architect, or Construction Manager. After each field visit, submit manufacturer’s written report of observations within 3 business days. The report shall note overall quality of work, deficiencies, and any other concerns, and recommend corrective actions.

B. Field Testing: Engage a qualified testing agency to perform field testing to determine if resilient athletic flooring complies with specified dynamic coefficient of friction.

1. Field testing is not required if manufacturer provides test data conducted with the last three years that installed resilient athletic flooring product meets performance requirements indicated.

C. If test results or inspections show resilient athletic flooring does not comply with requirements, remove and replace polish and/or replace the resilient athletic flooring as recommended in writing by manufacturer, and make further repairs after retesting and inspecting until resilient athletic flooring installation passes.

D. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

A. Perform the following operations immediately after completing flooring installation:

1. Remove adhesive and other blemishes from flooring surfaces.
2. Sweep and vacuum flooring thoroughly.
3. Damp-mop flooring to remove marks and soil after time period recommended in writing by manufacturer.

B. Protect flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

1. Do not move heavy and sharp objects directly over flooring. Protect flooring with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

C. Cover resilient athletic flooring until Substantial Completion.

END OF SECTION 096566

SECTION 096723 - RESINOUS FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Resinous urethane flooring system, also qualifying as a waterproof membrane.
2. Testing and application of systems for the reduction of moisture vapor transmission and alkalinity control for interior concrete slabs that are not in compliance with fluid-applied epoxy flooring manufacturer's written requirements.

B. Related Sections:

1. Section 012100 "Allowances" for moisture vapor emission control allowance.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to resinous flooring, including, but not limited to, the following:

a. Review of drawings and specifications affecting Work of this Section.
b. Protection of adjacent surfaces.
c. Surface preparation and substrate conditions.
d. Application.
e. Field quality control.
f. Protection of coating system.
g. Repair of coating system.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.

B. Sustainable Design Submittals: For resinous flooring components (primer, body, top coats), product data indicating VOC content.

C. Shop Drawings: Provide project-specific shop drawings for resinous flooring.

1. Include installation details, layout, and base.
2. Show details of special patterns.

D. Samples for Verification: For each resinous flooring system required, 6 inches square, applied to a rigid backing by Installer for this Project.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency.

C. Letter from manufacturer's technical representative indicating written acceptance of substrate.

D. Field quality control reports.

E. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For resinous flooring to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of resinous flooring that has been used for similar applications with successful results, that meets or exceeds performance requirements indicated, and of documenting this performance by inclusion in test reports. Manufacturer shall have factory-authorized service representatives who are available for consultation, periodic Project-site observations, and on-site assistance.

B. Installer Qualifications: A firm with not less than 10 years' experience installing resinous flooring similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section

C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards of material and execution.

1. Build mockups for resinous flooring including base and accessories.

a. Size: Minimum 100 sq. ft. of first installation of resinous flooring and cove base for each color and pattern in locations directed by Architect. Include 48-inch length of integral cove base.

2. Approval of mockup does not constitute approval of deviations from the Contractor Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.

B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.

C. Close spaces to traffic during resinous flooring application and for 24 hours after application unless manufacturer recommends a longer period.

1.10 WARRANTY

A. Special Warranty for Resinous Flooring: Manufacturer's standard or customized form in which manufacturer and installer agree to repair or replace components of resinous flooring that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, bubbling, blistering, cracking/crazing/alligatoring, delamination, failure to meet manufacturer's minimum published standards for traffic wear and durability.
2. Warranty Period: Ten (10) years from date of Substantial Completion.

B. Special Warranty for Moisture/Alkalinity Control System: Manufacturer's standard form in which Manufacturer agrees to repair or replace materials that fail to control water vapor transmission or fail to control alkalinity within specified warranty period.

1. This warranty includes, but is not limited to, the following:

a. Moisture control system.
b. Underlayments.
c. Resinous flooring system.
d. Labor.

2. Warranty Period: Ten (10) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain primary resinous flooring materials, including primers, waterproof membrane, base coat, undercoat, and top seal coats, from single source from single manufacturer. Obtain secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from manufacturer recommended in writing by manufacturer of primary materials.

2.2 RESINOUS FLOORING [RF-1]

A. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

1. Stonehard, Inc.; "StonTEC TRF" with integral cove base.

a. Waterproofing System Option: Include "Stonproof ME7" membrane system with texture #3 broadcast to refusal to qualify system as a waterproof membrane.

2. Or Comparable Equal, subject to compliance with specified requirements herein, and in compliance with Section 016000 "Product Requirements."

B. Resinous Flooring System: Abrasion-, impact-, and chemical-resistant, aggregate-filled, and resin-based monolithic floor surfacing designed to produce a seamless floor and integral cove base. System consists of a nominal 3/16-inch thick durable floor system with a decorative, slip-resistant, stain-resistant surface.

C. System Performance Characteristics:

1. Recommended Uses: Biotech, pharmaceutical, .

2. Color and Pattern: As indicated on Drawings, or if not indicated, as selected by Architect from manufacturer's full ranges.
3. Wearing Surface: Textured for slip resistance.

a. Dynamic Coefficient of Friction: Not less than 0.42 for level floor surfaces in accordance with ANSI B101.3.

4. Overall System Thickness: 3/16 inch.
5. Includes integral cove base.
6. Sustainable Design Requirements:

    a. Laboratory Test Reports: Flooring products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
    b. VOC Content:

        1) Primer: VOC content of not more than 100 g/L.
        2) Body and Topcoats: VOC content of not more than 100 g/L.

D. Primer: Type recommended by resinous flooring manufacturer for substrate and resinous flooring system indicated.

E. Waterproof Membrane: Type recommended by resinous flooring manufacturer for substrate and resinous flooring system indicated.

F. Reinforcing Membrane: Flexible resin formulation that is recommended by resinous flooring manufacturer for substrate and resinous flooring system indicated and that inhibits substrate cracks from reflecting through resinous flooring.

G. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.

H. Urethane Mortar Base Coat: A four-component, troweled, 100-percent solids urethane mortar system.

1. Nominal Thickness: 1/8 inch.

I. Undercoat: A two component, 100-percent solids, epoxy bonding coat. A colored coat that accepts the broadcast flakes.

J. Broadcast Flakes: Brightly colored decorative flakes.

1. Color: As selected by Architect from manufacturer's full range.

K. Urethane Sealer Coats: A two-component, UV-resistant, aliphatic polyaspartic urethane sealer.

1. Finish: Matte.
2. Number of seal coats: Two, in accordance with manufacturer's written instructions.

L. Cove Base: Manufacturer’s cove base mix matching resinous flooring system and broadcast aggregate.

M. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:

1. Tensile Strength: 1,000 psi according to ASTM D 638.
2. Impact Resistance: Minimum 160 in./lbs. according to ASTM D 4226.
3. Abrasion Resistance: Maximum 0.03 gm according to ASTM D 4060, CS-17.
4. Flexural Strength: 2,000 psi according to ASTM C 580.
5. Flexural Modulus of Elasticity: 1.1×10^{6} psi according to ASTM D 790.
6. Hardness: 80 according to ASTM D 2240, Shore D.
7. Flammability: Class I according to ASTM E 648.
8. Linear Coefficient of Thermal Expansion: 12×10^{-6} in./in. deg F according to ASTM C 531.
9. Compressive Strength: 5,000 psi after 7 days according to ASTM C 579.

2.3 RESINOUS FLOORING [RF-2] From Phase I spec; Dex-O-Tex actually installed.

A. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

1. Stonehard "StonShield HRI" System.

Or a Comparable Product by one of the following:

2. Crossfield Products Corp.; Dex-O-Tex "Cheminert CFS Flooring" system, including "Cheminert SC Membrane."

B. Resinous Flooring System: Abrasion-, impact-, and chemical-resistant, aggregate-filled, and resin-based monolithic floor surfacing designed to produce a seamless floor and integral cove base.

C. System Characteristics:

1. Color and Pattern: As indicated on Drawings, or if not indicated, as selected by Architect from manufacturer's available standard and optional colors and patterns.
2. Wearing Surface: In compliance with performance requirements.
3. Integral Cove Base: Height as indicated on Drawings.
4. Overall System Thickness: Nominal 1/4 inch.

D. System Components: Manufacturer's standard components that are compatible with each other and as follows:

1. Primer:
   a. Material Basis: Stonhard Standard Primer.
   b. Resin: Epoxy.
   c. Formulation Description: Two component, 100 percent solids.
   d. Application Method: Squeegee and roller.
   e. Number of Coats: One.

2. Mortar Base:
   a. Material Basis: Stonclad GS.
   b. Resin: Epoxy.
   c. Formulation Description: Three component, 100 percent solids.
   d. Application Method: Metal trowel.
      1) Thickness of Coats: Nominal 3/16 inch.
      2) Number of Coats: One.
   e. Aggregates: Pigmented blended aggregate.

3. Undercoat:
   a. Material Basis: Stonshield undercoat.
   b. Resin: Epoxy.
   c. Formulation Description: Two component, 100 percent solids, UV stable.
   d. Type: Clear.
   e. Finish: Gloss.
   f. Number of Coats: One.

4. Broadcast Media:
   a. Material Basis: Stonshield quartz aggregate.
   b. Type: Pigmented.
   c. Finish: Standard.
   d. Number of Coats: One.
   e. Pattern: Tweed.

5. Sealer:
   a. Material Basis: Stonshield sealer.
   b. Resin: Epoxy.
   c. Formulation Description: Two component, 100 percent solids, UV stable.
   d. Type: Clear.
   e. Finish: Gloss.
   f. Number of Coats: One.
   g. Texture Level: In compliance with performance requirements.

E. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:

1. Compressive Strength: 10,000 psi after 7 days per ASTM C 579.
2. Tensile Strength: 2,000 psi per ASTM C 307.
3. Flexural Strength: 4,300 psi per ASTM C 580.
4. Water Absorption: < 1% per ASTM C 413.
5. Impact Resistance: > 160 in. lbs. per ASTM D 2794.
6. Flammability: Class 1 per ASTM E-648.
7. Hardness: 85 to 90, Shore D per ASTM D 2240.

2.4 RESINOUS FLOORING [RF-3]

A. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

1. Crossfield Products Corp.; Dex-O-Tex Tek-Crete SL-F (Self-Leveling) and Tek-Crete Sealer.

Or a Comparable Product by one of the following:

2. General Polymers, a division of the Sherwin Williams Company; “FasTop S Urethane Slurry System.

B. Resinous Flooring System: Abrasion-, impact-, and chemical-resistant, aggregate-filled, and resin-based monolithic floor surfacing designed to produce a seamless floor and integral cove base.

C. System Characteristics:

1. Color and Pattern: As selected by Architect from manufacturer's full range.
2. Wearing Surface: Textured for slip resistance.
3. Approvals: Approved for food-processing environments.

D. Primer: Type recommended by resinous flooring manufacturer for substrate and resinous flooring system indicated.

E. Crack-Isolation Reinforcing Membrane: Flexible resin formulation that is recommended by resinous flooring manufacturer for substrate and resinous flooring system indicated and that inhibits substrate cracks from reflecting through resinous flooring.

F. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.

G. Body Coats:

1. Resin: Urethane.
2. Application Method: Flowable, self-leveling.
3. Thickness: 1/8 inch.
4. Aggregates: As selected by Architect from manufacturer's full range of standard and optional aggregates.

H. Top Coats: Sealing or finish coats.

1. Resin: Urethane.
2. Formula Description:
3. Type: Clear.
4. Number of Coats: Two.
5. Thickness: 10 mils per coat.
6. Finish: Matte.

I. Cove Base: Manufacturer’s cove base mix matching body coat and broadcast aggregate.

J. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:

1. Compressive Strength: 8,100 psi minimum according to ASTM C 579.
2. Tensile Strength: 1,000 psi minimum according to ASTM C 307.
3. Flexural Strength: 2,000 psi minimum according to ASTM D 580.
4. Surface Hardness: 85-90 according to ASTM D 2240 Shore D
5. Adhesion: Minimum 400 psi (100% failure in concrete) according to ASTM D 4541.
6. Water Absorption: 0.64 percent maximum according to MIL-D-3134.
7. Temperature Distortion: Passes according to Crossfield Lab dry, wet and oil at 250 deg F.
8. Critical Radiant Flux: 0.45 W/sq. cm or greater according to NFPA 253.

K. Moisture and Alkalinity Control System: As recommended by flooring manufacturer for mitigation of concrete slabs with moisture emissions and/or alkalinity measurements that are not within flooring manufacturer's written limitations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and areas, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resinous flooring.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to resinous flooring manufacturer's written instructions, and with oversight by manufacturer's technical representative, to ensure adhesion of flooring.

B. Clean substrates of substances, including oil, grease, and curing compounds, that might impair resinous flooring bond. Provide clean, dry substrate for resinous flooring application.

C. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.

1. Roughen concrete substrates as follows:

   a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
   b. Comply with ASTM C 811 requirements unless manufacturer's written instructions are more stringent.

2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.
3. Moisture, Alkalinity, and Bond Testing: Determine the suitability of the concrete subfloor for receiving the resinous flooring with regard to pH level and moisture content by moisture and alkalinity tests. Conduct moisture testing in accordance with ASTM F 1869 (calcium chloride) and ASTM F 2170 (relative humidity) unless otherwise recommended by the resinous flooring manufacturer. Conduct alkalinity testing as recommended by the resinous flooring manufacturer. Determine the compatibility of the resinous flooring system to the concrete floors by a bond test in accordance with the resinous flooring manufacturer's recommendations. Submit copy of test reports for moisture and alkalinity content of concrete slab, and bond test, stating date of test, person conducting the test, and the area tested.

   a. Apply moisture and alkalinity control system as recommended by resinous flooring manufacturer. Proceed with installation only after substrates pass testing.

D. Substrate Tolerance: Where substrate tolerances are not in compliance with resinous flooring manufacturer's written instructions, produce a level surface in accordance with manufacturer's written instructions and the following:

1. Measure surface, grind high spots, fill low spots, so gap at any point between concrete surface and an unleveled, freestanding, 10-ft-long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.
2. Use compatible trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.

E. Control Joint and Crack Treatment: Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written instructions.

F. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.

G. Installation of resinous flooring indicates acceptance of surfaces and conditions.

3.3 APPLICATION

A. Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface.

1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
3. Expansion and Isolation Joint Treatment: At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.

B. Primer: Apply primer over prepared substrate at manufacturer's recommended spreading rate.

C. Waterproof Membrane: Apply waterproof membrane over entire substrate surface, in manufacturer's recommended thickness.

1. Apply waterproofing membrane to integral cove base substrates.

D. Reinforcing Membrane: Apply reinforcing membrane over entire deck substrates.

1. Apply reinforcing membrane to integral cove base substrates.

E. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details, including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners.

1. Integral Cove Base: As indicated on Drawings, but no less than 4 inches high.

F. Base Coat: Apply troweled base coats in thickness indicated for flooring system and in accordance with manufacturer's written installation instructions.

G. Undercoat: Apply undercoat in thickness indicated for flooring system, and in accordance with manufacturer's written installation instructions.

1. Aggregates: Broadcast aggregates at rate recommended by manufacturer and, after resin is cured, remove excess aggregates to provide surface texture indicated.

H. Seal Topcoats: Apply two topcoats for flooring system and at spreading rates recommended in writing by manufacturer and to produce wearing surface in accordance with performance requirements.

I. Cure resinous flooring according to manufacturer's written instructions, taking care to prevent contamination during application stages and before completing curing process. Close application area for a minimum of 24 hours.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Engage manufacturer's representative for technical assistance and guidance for surface preparation and application of resinous flooring system. Arrange for manufacturer's representative to observe initial installation (mock-up) of resinous flooring system, at mid-point of the installation, and at completion. Provide additional field observations when requested by Architect or General Contractor. After each field visit, submit manufacturer's written report of observations within 3 business days. The report shall note overall quality of work, deficiencies, and any other concerns, and recommend corrective action.

B. Field Testing: Engage a qualified testing agency to perform field testing to determine if resinous flooring system, including sealer, complies with specified coefficient of friction.

1. Field testing is not required if manufacturer provides test reports confirming compliance with performance requirements.

3.5 PROTECTION

A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

1. Do not move heavy and sharp objects directly over flooring. Protect flooring with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

END OF SECTION 096723

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Modular carpet tile.
2. Testing and application of systems for the reduction of moisture vapor transmission and alkalinity control for interior concrete slabs that are not in compliance with tile carpeting manufacturer's written requirements.

B. Related Requirements:

1. Section 012100 "Allowances" for moisture vapor emission control allowance.
2. Section 035416 "Hydraulic Cement Underlayment" for self-leveling hydraulic cement underlayment at concrete floor substrates.
3. Section 096513 "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet.
4. Section 096816 "Sheet Carpeting" for sheet carpeting and carpet cushion.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to carpet tile installation including, but not limited to, the following:

a. Review delivery, storage, and handling procedures.
b. Review ambient conditions and ventilation procedures.
c. Review subfloor preparation procedures.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
2. Include manufacturer's written installation recommendations for each type of substrate.
3. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E 648 by an independent testing and inspecting agency.

B. Sustainable Design Submittals:

1. For tile carpeting, product data indicating compliance with sustainable design performance requirements.
2. For adhesives, product data indicating VOC content.

C. Shop Drawings: Provide project-specific shop drawings for each type of tile carpeting. Include plans showing the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
2. Carpet tile type, color, and dye lot.
3. Type of subfloor.
4. Type of installation.
5. Pattern of installation.
6. Pattern type, location, and direction.
7. Pile direction.
8. Type, color, and location of insets and borders.
9. Type, color, and location of edge, transition, and other accessory strips.
10. Transition details to other flooring materials.

D. Samples for Verification: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size Sample.
2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch-long Samples.

E. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

1.5 IINFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.

C. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:

1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd..

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of tile carpeting that has been used for similar applications with successful results, that meets or exceeds performance requirements indicated, and of documenting this performance by inclusion in test reports.

B. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association.

C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Build mockups for tile carpeting including resilient base and accessories.

a. Size: First 100 sq. ft. of installation for each type, color, and pattern in locations directed by Architect.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI's "CRI Carpet Installation Standard."

1.10 FIELD CONDITIONS

A. Comply with CRI's "CRI Carpet Installation Standard" for temperature, humidity, and ventilation limitations.

B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.

C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.11 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer’s standard or customized non-prorated warranty in which manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Failures include, but are not limited to, the following:

a. More than 15 percent edge raveling, snags, zippering and runs.
b. Dimensional instability.
c. Excess static discharge. Excessive static discharge means more than 3.0 kilovolts when tested per AATCC 134 at a relative humidity of 20% and room temperature of 70% F.
d. Resiliency Loss of Backing: More than 10-percent loss of backing resiliency.
e. Loss of tuft-bind strength.
f. Loss of face fiber.
g. Delamination.

3. Warranty Period: Ten (10) years from date of Substantial Completion.

B. Special Warranty for Moisture/Alkalinity Control System: Manufacturer’s standard or customized warranty in which manufacturer and installer agree to repair or replace materials that fail to control water vapor transmission or fail to control alkalinity within specified warranty period.

1. This warranty includes, but is not limited to, the following:

a. Moisture control system.
b. Underlayments.
c. Floor covering system
d. Labor.

2. Warranty Period: Ten (10) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide products from the following:

1. As indicated on Drawings.

B. Source Limitations: Provide tile carpeting from single source from single manufacturer.

2.2 CARPET TILE

A. Color: As indicated on Drawings.

B. Pattern: As indicated on Drawings.

C. Primary Backing/Backcoating: Manufacturer's standard composite materials.

D. Secondary Backing: Manufacturer's standard material.

E. Size: As indicated on Drawings.

F. Applied Treatments:

1. Soil-Resistance Treatment: Manufacturer's standard treatment.
2. Antimicrobial Treatment: Manufacturer's standard treatment that protects carpet tiles as follows:

G. Sustainable Design Requirements: Carpet and carpet tile shall comply with the following:

1. All carpet installed in the building interior shall meet the testing and product requirements of the following:

a. Carpet and Rug Institute's Green Label Plus Program.

2. All carpet cushion installed in the building interior shall meet the requirements of the Carpet and Rug Institute's Green Label program.
3. All carpet adhesive shall have a VOC content of 50 g/L or less.

H. Performance Characteristics:

1. Appearance Retention Rating (TARR), not less than the following according to ASTM D 7330:

a. Special traffic, 3.5 minimum, for stairs and elevators.
b. Severe traffic, 3.5 minimum, for public areas, entrances, lobbies, corridors, dining areas:
c. Moderate traffic, 3.0 minimum, for all other rooms or spaces.

2. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm according to NFPA 253.
3. Optical Density Smoke Rating: Not to exceed 450 per ASTM E 662 (per 2016 CBC Section 804.4).
4. Dry Breaking Strength: Not less than 100 lbf according to ASTM D 2646.
5. Dimensional Tolerance: Within 1/32 inch of specified size dimensions, as determined by physical measurement.
6. Dimensional Stability: 0.2 percent or less according to ISO 2551 (Aachen Test).
7. Electrostatic Propensity: Less than 3.5 kV according to AATCC 134.
8. Carpet shall be in compliance with 2010 ADA Section 302.2:

a. Carpet or carpet tile shall be securely attached and shall have a firm cushion, pad, or backing or no cushion or pad. Carpet or carpet tile shall have a level loop, textured loop, level cut pile, or level cut/uncut pile texture. Pile height shall be 1/2 inch maximum. Exposed edges of carpet shall be fastened to floor surfaces and shall have trim on the entire length of the exposed edge. Carpet edge trim shall comply with Section 303.

I. Visual Characteristics and Product Options: Information on Drawings and in specifications establishes requirements for aesthetic effects. Aesthetic effects are indicated by colors, patterns, arrangements, alignments and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

2.3 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Moisture and Alkalinity Control System: As recommended by carpet tile manufacturer for mitigation of concrete slabs with moisture emissions and/or alkalinity measurements that are not within carpet tile manufacturer's written limitations.

C. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.

D. Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer and manufacturer's representative present, for compliance with requirements for maximum moisture content, installation tolerances, and other conditions affecting carpet tile performance.

B. Examine carpet tile for type, color, pattern, and potential defects.

C. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of tile carpeting.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to CRI's "CRI Carpet Installation Standards" and manufacturer's written instructions, and with oversight by manufacturer's representative, to ensure adhesion of tile carpet.

B. Concrete Substrates:

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners prior to testing and prior to flooring application

2. Mechanically remove, according to manufacturer's written instructions, laitance, glaze, efflorescence, curing compounds, sealers, and hardeners, and other substances that are incompatible with carpet flooring materials and that contain soap, wax, oil or silicone, without using solvents.

3. Moisture, Alkalinity, and Bond Testing: Determine the suitability of the concrete subfloor for receiving the tile carpeting with regard to moisture content and pH level by moisture and alkalinity tests. Conduct moisture testing in accordance with ASTM F 1869 (calcium chloride) and ASTM F 2170 (relative humidity) unless otherwise recommended by the carpet tile manufacturer. Conduct alkalinity testing as recommended by the carpet tile manufacturer. Determine the compatibility of the carpet tile adhesives to the concrete floors by a bond test in accordance with the carpet tile manufacturer's recommendations. Submit copy of test reports for moisture and alkalinity content of concrete slab, and bond test, stating date of test, person conducting the test, and the area tested.

   a. Apply moisture and alkalinity control system as recommended by carpet tile manufacturer. Proceed with installation only after substrates pass testing.

C. Substrate Tolerance: Where substrate tolerances are not in compliance with tile carpeting manufacturer's written instructions, produce a level surface in accordance with manufacturer's written instructions and the following:

1. Measure surface, grind high spots (of concrete, and prior to application of any vapor control system), fill low spots, so gap at any point between floor substrate surface and an unleveled, freestanding, 10-ft-long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.
2. Use compatible trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.

D. Scrape, sand, sweep, and vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

A. General: Comply with CRI's "CRI Carpet Installation Standard," Section 18, "Modular Carpet" and with carpet tile manufacturer's written installation instructions.

B. Installation Method: As recommended in writing by carpet tile manufacturer.

C. Maintain dye-lot integrity. Do not mix dye lots in same area.

D. Maintain pile-direction patterns recommended in writing by carpet tile manufacturer.

E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.

H. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:

1. Remove excess adhesive and other surface blemishes using cleaner recommended by carpet tile manufacturer.
2. Remove yarns that protrude from carpet tile surface.
3. Vacuum carpet tile using commercial machine with face-beater element.

B. Protect installed carpet tile to comply with CRI's "CRI Carpet Installation Standard," Section 20, "Protecting Indoor Installations."

C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813

SECTION 096816 - SHEET CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Sheet carpet.
2. Carpet cushion.
3. Testing and application of systems for the reduction of moisture vapor transmission and alkalinity control for interior concrete slabs that are not in compliance with sheet carpeting manufacturer's written requirements.

B. Related Requirements:

1. Section 012100 "Allowances" for moisture vapor emission control allowance.
2. Section 035416 "Hydraulic Cement Underlayment" for self-leveling hydraulic cement underlayment at concrete floor substrates.
3. Section 096513 "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet.
4. Section 096813 "Tile Carpeting" for tile carpeting.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to carpet installation including, but not limited to, the following:

a. Review delivery, storage, and handling procedures.
b. Review ambient conditions and ventilation procedures.
c. Review subfloor preparation procedures.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written data on physical characteristics and durability.
2. Include manufacturer's written installation recommendations for each type of substrate.
3. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E 648 by an independent testing and inspecting agency.

B. Sustainable Design Submittals:

1. For sheet carpeting, product data indicating compliance with sustainable design performance requirements.
2. For adhesives, product data indicating VOC content.

C. Shop Drawings: Provide project-specific shop drawings for each type of sheet carpeting. Include plans showing the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet.
2. Carpet type, color, and dye lot.
3. Locations where dye lot changes occur.
4. Seam locations, types, and methods.
5. Type of subfloor.
6. Type of installation.
7. Pattern type, repeat size, location, direction, and starting point.
8. Pile direction.
9. Types, colors, and locations of insets and borders.
10. Types, colors, and locations of edge, transition, and other accessory strips.
11. Transition details to other flooring materials.
12. Type of carpet cushion.

D. Samples for Verification: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet: 12-inch-square Sample.
2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch-long Samples.
3. Carpet Cushion: 6-inch square sample.
4. Carpet Seam: 6-inch Sample.

E. Product Schedule: For carpet. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Product Test Reports: For carpet, for tests performed by a qualified testing agency.

C. Sample Warranties: For special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For carpet to include in maintenance manuals. Include the following:

1. Methods for maintaining carpet, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet: Full-width rolls equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd..

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of sheet carpeting that has been used for similar applications with successful results, that meets or exceeds performance requirements indicated, and of documenting this performance by inclusion in test reports.

B. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association.

C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Build mockups for sheet carpeting including resilient base and accessories.

a. Size: First 100 sq. ft. of installation for each type, color, and pattern in locations directed by Architect.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI's "CRI Carpet Installation Standard."

B. Deliver carpet in original mill protective covering with mill register numbers and tags attached.

1.10 FIELD CONDITIONS

A. Comply with CRI's "CRI Carpet Installation Standard" for temperature, humidity, and ventilation limitations.

B. Environmental Limitations: Do not deliver or install carpet until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.

C. Do not install carpet over concrete slabs until slabs have cured, are sufficiently dry to bond with adhesive, and have pH range recommended by carpet manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet, install carpet before installing these items.

1.11 WARRANTY

A. Special Warranty for Carpet: Manufacturer standard or customized non-prorated warranty in which manufacturer agrees to repair or replace components of carpet installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Failures include, but are not limited to, the following:

a. More than 15 percent loss of face fiber, edge raveling, snags, and runs.
b. Loss of tuft bind strength.
c. Loss of face fiber.
d. Excess static discharge. More than 3.0 kV per AATCC 134.
e. Resiliency Loss of Backing: More than 10-percent loss of backing resiliency.
f. Delamination.
g. Edge Ravel
h. Zippering.

3. Warranty Period: Ten (10) years from date of Substantial Completion.

B. Special Warranty for Moisture/Alkalinity Control System: Manufacturer's standard or customized warranty in which manufacturer and installer agree to repair or replace materials that fail to control water vapor transmission or fail to control alkalinity within specified warranty period.

1. This warranty includes, but is not limited to, the following:

a. Moisture control system.
b. Underlayments.
c. Floor covering system.
d. Labor.

2. Warranty Period: Ten (10) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide products from the following:

1. As indicated on Drawings.

B. Source Limitations: Provide sheet carpeting from single source from single manufacturer.

2.2 SHEET CARPET

A. Color: As indicated on Drawings.

B. Pattern: As indicated on Drawings.

C. Primary Backing/Backcoating: Manufacturer's standard composite materials.

D. Secondary Backing: Manufacturer's standard material.

E. Applied Treatments:

1. Soil-Resistance Treatment: Manufacturer's standard treatment.

F. Sustainable Design Requirements: Carpet and carpet tile shall comply with the following:

1. All carpet installed in the building interior shall meet the testing and product requirements of the following:

a. Carpet and Rug Institute's Green Label Plus Program.

2. All carpet cushion installed in the building interior shall meet the requirements of the Carpet and Rug Institute's Green Label program.
3. All carpet adhesive shall have a VOC content of 50 g/L or less.

G. Performance Characteristics:

1. Appearance Retention Rating (TARR), not less than the following according to ASTM D 7330:

a. Special traffic, 3.5 minimum, for stairs and elevators.
b. Severe traffic, 3.5 minimum, for public areas, entrances, lobbies, corridors, dining areas:
c. Moderate traffic, 3.0 minimum, for all other rooms or spaces.

2. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm according to NFPA 253.
3. Optical Density Smoke Rating: Not to exceed 450 per ASTM E 662 (per 2016 CBC Section 804.4).
4. Dry Breaking Strength: Not less than 100 lbf according to ASTM D 2646.
5. Electrostatic Propensity: Less than 3.5 kV according to AATCC 134.
6. Carpet shall be in compliance with 2010 ADA Section 302.2:

    a. Carpet or carpet tile shall be securely attached and shall have a firm cushion, pad, or backing or no cushion or pad. Carpet or carpet tile shall have a level loop, textured loop, level cut pile, or level cut/uncut pile texture. Pile height shall be 1/2 inch maximum. Exposed edges of carpet shall be fastened to floor surfaces and shall have trim on the entire length of the exposed edge. Carpet edge trim shall comply with Section 303.

H. Visual Characteristics and Product Options: Information on Drawings and in specifications establishes requirements for aesthetic effects. Aesthetic effects are indicated by colors, patterns, arrangements, alignments and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

2.3 CARPET CUSHION

A. Performance Characteristics:

1. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm according to NFPA 253.
2. Sustainable Design Requirements: Comply with "Sustainable Design Requirements" Article above.
3. Cushion Type: As recommended by sheet carpeting manufacturer for conditions indicated.
4. Traffic Classification:

    a. Class III, extra heavy traffic: For public areas and restaurants.
    b. Class II, heavy: For all other areas.

2.4 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet manufacturer.

B. Moisture and Alkalinity Control System: As recommended by carpet manufacturer for mitigation of concrete slabs with moisture emissions and/or alkalinity measurements that are not within carpet manufacturer's written limitations.

C. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and is recommended or provided by carpet manufacturer.

1. VOC Content: 50 g/L or less.

D. Seam Adhesive: Hot-melt adhesive tape or similar product recommended by carpet manufacturer for sealing and taping seams and butting cut edges at backing to form secure seams and to prevent pile loss at seams.

E. Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance.

B. Examine carpet for type, color, pattern, and potential defects.

C. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of sheet carpeting.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Comply with CRI's "CRI Carpet Installation Standard" and with carpet manufacturer's written installation instructions for preparing substrates.

B. Concrete Substrates:

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners prior to testing and prior to flooring application

2. Mechanically remove, according to manufacturer’s written instructions, laitance, glaze, efflorescence, curing compounds, sealers, and hardeners, and other substances that are incompatible with carpet flooring materials and that contain soap, wax, oil or silicone, without using solvents.

3. Moisture, Alkalinity, and Bond Testing: Determine the suitability of the concrete subfloor for receiving the carpeting with regard to moisture content and pH level by moisture and alkalinity tests. Conduct moisture testing in accordance with ASTM F 1869 (calcium chloride) and ASTM F 2170 (relative humidity) unless otherwise recommended by the carpet manufacturer. Conduct alkalinity testing as recommended by the carpet manufacturer. Determine the compatibility of the carpet adhesives to the concrete floors by a bond test in accordance with the carpet manufacturer’s recommendations. Submit copy of test reports for moisture and alkalinity content of concrete slab, and bond test, stating date of test, person conducting the test, and the area tested.

a. Apply moisture and alkalinity control system as recommended by carpet manufacturer. Proceed with installation only after substrates pass testing.

C. Substrate Tolerance: Where substrate tolerances are not in compliance with carpet manufacturer’s written instructions, produce a level surface in accordance with manufacturer’s written instructions and the following:

1. Measure surface, grind high spots (of concrete, and prior to application of any vapor control system), fill low spots, so gap at any point between floor substrate surface and an unleveled, freestanding, 10-ft-long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.
2. Use compatible trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.

D. Scrape, sand, sweep, and vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 CARPET INSTALLATION

A. Comply with CRI's "CRI Carpet Installation Standard" and carpet manufacturer's written installation instructions for double-glue-down installation.

B. Comply with carpet manufacturer's written instructions and Shop Drawings for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position.

C. Install pattern parallel to walls and borders unless otherwise indicated on Drawings.

D. Install borders with mitered corner seams.

E. Do not bridge building expansion joints with carpet.

F. Cut and fit carpet to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet manufacturer.

G. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

H. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet as marked on subfloor. Use nonpermanent, nonstaining marking device.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet:

1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.
2. Remove yarns that protrude from carpet surface.
3. Vacuum carpet using commercial machine with face-beater element.

B. Protect installed carpet to comply with CRI's "CRI Carpet Installation Standard."

C. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods recommended in writing by carpet manufacturer.

END OF SECTION 096816

SECTION 097200 - WALL COVERINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes vinyl wall covering.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include data on physical characteristics, durability, fade resistance, and fire-test-response characteristics.

B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.
2. Certifications: For wall coverings.

C. Shop Drawings: Show location and extent of each wall-covering type. Indicate pattern placement, seams and termination points.

D. Samples for Verification: For each type of wall covering and for each color, pattern, texture, and finish specified, full width by 36-inch- long in size.

1. Wall-Covering Sample: From same production run to be used for the Work. Show complete pattern repeat. Mark top and face of fabric.

E. Product Schedule: For wall coverings. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Product Test Reports: For each wall covering, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For wall coverings to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Wall-Covering Materials: For each type, color, texture, and finish, full width by length to equal to 5 percent of amount installed.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of wall coverings that have been used for similar applications with successful results, that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports.

B. Installer Qualifications: A firm with not less than 5 years' experience installing wall coverings similar in material, design, and extent to that indicated for this Project, and whose work has resulted in installations with a record of successful in-service performance.

C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for installation.

1. Build mockups for each type of wall covering on each substrate required. Comply with requirements in ASTM F 1141 for appearance shading characteristics.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver wallcoverings to the project site in unbroken and undamaged original factory packaging and clearly labeled with the manufacturer's identification label, quality or grade, and lot number.

B. Store materials in a clean, dry storage area with temperatures maintained above 55 deg F with normal humidity.

C. Store materials within original packaging to prevent damage.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install wall coverings until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at levels intended for occupants after Project completion during the remainder of the construction period.

B. Lighting: Do not install wall covering until lighting that matches conditions intended for occupants after Project completion is provided on the surfaces to receive wall covering.

C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-covering manufacturer for full drying or curing.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: As determined by testing identical wall coverings applied with identical adhesives to substrates according to test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency, and shall comply with Chapter 8 of the 2016 California Building Code.

1. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 450 or less.

2. For rooms or spaces that are not protected by an automatic sprinkler system, wall coverings shall also comply with the following:

a. Fire-Growth Contribution: No flashover and heat and smoke release according to NFPA 265 or NFPA 286.

B. Sustainable Design Requirements:

1. Adhesives shall comply with 2016 CALGreen mandatory measures:

a. Adhesives: Adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers and caulks shall comply with local or regional air pollution control or air quality management district rules where applicable, or SCAQMD Rule 1168 VOC limits, as shown in 2016 CALGreen Tables 5.504.4.1 and 5.504.4.2. Such products also shall comply with the Rule 1168 prohibition on the use of certain toxic compounds (chloroform, ethylene dichloride methylene chloride, perchloroethylene and trichloroethylene). Adhesives shall have no added formaldehyde resins.

2. Adhesive shall have a VOC content of 50 g/L or less.
3. Wall coverings shall be certified to comply with the Wall Covering Association Standard NSF/ANSI 342.

C. Micro-Venting / Micro Perforations: For wall covering subject to high humidity (rooms or spaces with running water and where indicated), provide wall coverings and wall paper that have been micro perforated.

D. Visual Characteristics and Product Options: Information on Drawings and in specifications establishes requirements for aesthetic effects. Aesthetic effects are indicated by colors, patterns, arrangements, alignments and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

2.2 MANUFACTURERS

A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide products from the following:

1. As indicated on Drawings.

B. Source Limitations: Provide wall coverings from single source from single manufacturer.

2.3 WALL COVERINGS

A. Description: Provide mildew-resistant wallpaper in rolls from same production run and that complies with ASTM F 793.

B. Colors, Textures, and Patterns: As indicated on Drawings.

2.4 ACCESSORIES

A. Adhesive: Mildew-resistant, nonstaining adhesive, for use with specific wall covering and substrate application indicated and as recommended in writing by wall-covering manufacturer.

1. Adhesives shall have a VOC content of 50 g/L or less.

B. Primer/Sealer: Mildew resistant, complying with requirements in Section 099123 "Interior Painting" and recommended in writing by primer/sealer and wall-covering manufacturers for intended substrate.

C. Wall Liner: Nonwoven, synthetic underlayment and adhesive as recommended by wall-covering manufacturer.

D. Seam Tape: As recommended in writing by wall-covering manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for levelness, wall plumbness, maximum moisture content, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Comply with manufacturer's written instructions for surface preparation.

B. Clean substrates of substances that could impair bond of wall covering, including dirt, oil, grease, mold, mildew, and incompatible primers.

C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.

1. Gypsum Board: Prime with primer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
2. Painted Surfaces: Treat areas susceptible to pigment bleeding.

D. Check painted surfaces for pigment bleeding. Sand gloss, semigloss, and eggshell finish with fine sandpaper.

E. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

F. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

3.3 WALL LINER INSTALLATION

A. Install wall liner, without gaps or overlaps. Form smooth wrinkle-free surface for finished installation. Do not begin wall-covering installation until wall liner has dried.

3.4 WALL-COVERING INSTALLATION

A. Comply with wall-covering manufacturers' written installation instructions applicable to products and applications indicated.

B. Cut wall-covering strips in roll number sequence. Change the roll numbers at partition breaks and corners.

C. Install strips in same order as cut from roll.

1. For solid-color, even-texture, or random-match wall coverings, reverse every other strip.

D. Install wall covering without lifted or curling edges and without visible shrinkage.

E. Install seams vertical and plumb at least 6 inches from outside corners and 6 inches from inside corners unless a change of pattern or color exists at corner. Horizontal seams are not permitted.

F. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without overlaps or gaps between strips.

G. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.

3.5 CLEANING

A. Remove excess adhesive at seams, perimeter edges, and adjacent surfaces.

B. Use cleaning methods recommended in writing by wall-covering manufacturer.

C. Replace strips that cannot be cleaned.

D. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

END OF SECTION 097200

SECTION 099113 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes surface preparation and the application of paint systems on the following exterior substrates:

1. Concrete.
2. Steel.
3. Galvanized metal.
4. Portland cement plaster (stucco).
5. Field-paint HVAC, electrical, plumbing and any other similar equipment where exposed to view or exposed to weather and not factory painted.
6. As indicated.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for shop priming metal substrates.
2. Section 051213 "Architecturally Exposed Structural Steel Framing" for shop priming AESS.
3. Section 055000 "Metal Fabrications" for shop priming metal fabrications.
4. Section 081113 "Hollow Metal Doors and Frames" for shop priming hollow metal doors and frames.
5. Section 099113 "Interior Painting" for surface preparation and the application of paint systems on interior substrates.
6. Section 099300 "Staining and Transparent finishin"" for wood substrates indicated to receive a stain or transparent finish.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.

B. Sustainable Design Submittals: For paints and coatings, product data indicating VOC content.

C. Samples for Verification: For each type of paint system and each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and painter.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm regularly engaged in producing paint products that have been used for similar applications with successful results, capable of producing paint products that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports. Manufacturer's paint products shall comply with MPI standards and shall be listed in its "MPI Approved Products Lists."

B. Painter Qualifications: A painting firm with not less than 10 years' experience with work similar in material, design, and extent to that indicated for this Project and whose work has resulted in installations with a record of successful in-service performance. Painting firm shall be a member of the Painting and Decorating Contractors of America.

C. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft.
b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 85 deg F.

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide the following:

1. Sherwin-Williams Company (The).

Or a comparable product by one of the following:

2. Benjamin Moore & Co.

B. Source Limitations: Obtain exterior paint materials from single source from single manufacturer.

2.2 PAINT, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

B. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

C. VOC Content: Products shall comply with the following VOC limits.

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 100 g/L.
3. Primers, Sealers, and Undercoaters: 100 g/L.
4. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
5. Zinc-Rich Industrial Maintenance Primers: 340 g/L.

D. Colors: As indicated on Drawings.

2.3 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Owner may engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Portland Cement Plaster: 12 percent.

C. Portland Cement Plaster Substrates: Verify that plaster is fully cured.

D. Begin coating no sooner than 30 days after substrate is constructed and is visually dry on both sides.

E. Verify that substrate is within the range of alkalinity recommended by manufacturer.

F. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

G. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions. Pressure clean to remove all dirt, dust, grease, oil, loose particles, laitance, foreign material, peeling and defective coatings, chalks, etc. Allow the surface to dry before prime/paint application.

E. Steel Substrates: Clean substrates to be coated. Remove loose rust and mill scale and splatter, slag, or flux deposits. Prepare surfaces according to the paint manufacturer’s written instructions, but no less than the following specification standard:

1. Blast clean according to SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints. Prepare galvanized surfaces according to the paint manufacturer’s written instructions.

3.3 APPLICATION

A. Apply paints and elastomeric coatings according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Primers: Apply at a rate to ensure complete coverage.

C. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.

D. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

E. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

F. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed to view:

a. Equipment, including panelboards.
b. Uninsulated metal piping.
c. Uninsulated plastic piping.
d. Pipe hangers and supports.
e. Metal conduit.
f. Plastic conduit.
g. Tanks that do not have factory-applied final finishes.
h. As indicated.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

A. Concrete Substrates:

1. Water Blocking Primer / Finish:

a.	Prime Coat:	Sherwin Williams "Water Blocking Primer/Finish," B72W08010.*
b.	Intermediate Coat:	Sherwin Williams "Water Blocking Primer/Finish," B72W08010.*
c.	Top Coat:	Sherwin Williams "Duration Exterior Latex Finish," K32-200 Series.
d.	Water Resistance:	12 psi in accordance with ASTM D 7088-04.
		*Apply product to achieve a pin-hole free surface.

B. Steel Substrates:

1. Light Industrial Coating System, Water-Based:

a.	Prime Coat:	Primer, rust-inhibitive, water based, MPI #107.
b.	Intermediate Coat:	Light industrial coating, water based, matching top coat.
c.	Top Coat:	Light industrial coating, exterior, water based, semi-gloss, MPI #163.
		Light industrial coating, exterior, water based, gloss, MPI #164.

C. Galvanized-Metal Substrates:

1. Light Industrial Coating System, Water-Based:

a.	Prime Coat:	Primer, galvanized, water based, MPI #134.
b.	Intermediate Coat:	Light industrial coating, exterior, water based, matching topcoat.
c.	Top Coat:	Light industrial coating, exterior, water based, semi-gloss, MPI #163.
		Light industrial coating, exterior, water based, gloss, MPI #164.

D. Portland Cement Plaster (Stucco):

1. Elastomeric Coating System:

a.	Prime Coat:	As recommended in writing by topcoat manufacturer.
b.	Intermediate Coat:	As recommended in writing by topcoat manufacturer.
c.	Top Coat:	Elastomeric, pigmented, exterior, water-based, flat coating, MPI #113.

END OF SECTION 099113

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes surface preparation and the application of paint systems on the following interior substrates:

1. Concrete.
2. Steel.
3. Gypsum board.
4. Where indicated.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for shop priming metal substrates.
2. Section 051213 "Architecturally Exposed Structural Steel Framing" for shop priming AESS.
3. Section 055000 "Metal Fabrications" for shop priming metal fabrications.
4. Section 055113 "Metal Pan Stairs" for shop priming metal pain stairs and railings.
5. Section 081113 "Hollow Metal Doors and Frames" for shop priming hollow metal doors and frames.
6. Section 099113 "Exterior Painting" for surface preparation and the application of paint systems on exterior substrates.
7. Section 099300 "Staining and Transparent Finishing" for wood substrates indicated to receive a stain or transparent finish.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.

B. Sustainable Design Submittals: For paints and coatings, product data indicating VOC content.

C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.

1. Submit samples on rigid backing, 8 inches square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and painter.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm regularly engaged in producing paint products that have been used for similar applications with successful results, capable of producing paint products that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports. Manufacturer's paint products shall comply with MPI standards and shall be listed in its "MPI Approved Products Lists."

B. Painter Qualifications: A painting firm with not less than 10 years' experience with work similar in material, design, and extent to that indicated for this Project and whose work has resulted in installations with a record of successful in-service performance. Painting firm shall be a member of the Painting and Decorating Contractors of America.

C. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft..
b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 85 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide paint products by the following:

1. Sherwin-Williams Company (The).

Or a comparable product by one of the following:

2. Benjamin Moore & Co.

B. Source Limitations: Obtain interior paint materials from single source from single manufacturer.

2.2 PAINT, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

B. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction.

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 100 g/L.
3. Primers, Sealers, and Undercoaters: 100 g/L.
4. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
5. Zinc-Rich Industrial Maintenance Primers: 340 g/L.

D. Colors: As indicated on Drawings.

2.3 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Owner may engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Gypsum Board: 12 percent.

C. Begin coating no sooner than 30 days after substrate is constructed and is visually dry on both sides.

D. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

E. Gypsum Board Substrates Indicated to Receive a Dry Erase Coating: Verify gypsum board substrates have received a Level 5 finish as specified in Section 092900 “Gypsum Board.”

F. Verify that substrate is within the range of alkalinity recommended by manufacturer.

G. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

H. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions. Remove all dirt, dust, grease, oil, loose particles, laitance, foreign material, peeling and defective coatings, chalks, etc. Allow the surface to dry before prime/paint application.

E. Steel Substrates: Steel Substrates: Clean substrates to be coated. Remove loose rust and mill scale and splatter, slag, or flux deposits. Prepare surfaces according to the paint manufacturer’s written instructions,

F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints. Prepare galvanized surfaces according to the paint manufacturer’s written instructions.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Primers: Apply at a rate to ensure complete coverage.

C. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

D. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

E. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

F. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed in occupied spaces:

a. Equipment, including panelboards.
b. Uninsulated metal piping.
c. Uninsulated plastic piping.
d. Pipe hangers and supports.
e. Metal conduit.
f. Plastic conduit.
g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
h. Other items as directed by Architect.

2. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Nontraffic Surfaces:

1. High-Performance Architectural Latex System:

a. Prime Coat: Primer, alkali resistant, water based, MPI #3.
b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
c. Topcoat:
SemiGloss: Latex, interior, high performance architectural, semi-gloss, MPI #141.
Eggshell: Latex, interior, high performance architectural, flat, MPI #131

B. Steel Substrates (Dry Locations):

1. High-Performance Architectural Latex System:

a. Prime Coat: Primer, rust-inhibitive, water based, MPI #107.
b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
c. Topcoat: Latex, interior, high performance architectural, semi-gloss MPI Gloss Level 5, MPI #141.

C. Steel Substrates (Wet Locations):

1. Match painting system for exterior steel substrates. See Section 099113 "Exterior Painting."

D. Gypsum Board Substrates:

1. High-Performance Architectural Latex System:

a. Prime Coat: MPI #50: Primer Sealer, Latex, Interior.

b. Ceilings:
1) Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
2) Top Coat: Latex, interior, high performance architectural; flat. MPI Gloss Level 2; MPI #138.

c. Walls (indicated as semi-gloss):
1) Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
2) Top Coat: Latex, Interior, high performance architectural; semi-gloss. MPI Gloss Level 5; MPI #141.

d. Walls (indicated as satin / eggshell):
1) Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
2) Top Coat: Latex, Interior, high performance architectural – eggshell. MPI Gloss Level 3; MPI #139

e. Walls at all labs, , other similar wet spaces, and where indicated, paint system shall also be designated as "epoxy."

1) Intermediate Coat: SW Pre-Catalyzed Waterbased Epoxy Eg-Shel.
2) Top Coat: SW Pre-Catalyzed Waterbased Epoxy Eg-Shel.

E. Dry Erase Coatings:

1. Walls:

a. Walls Substrate Provide prime, intermediate, and top coats as specified above.
b. Dry Erase Coat: SW Dry Erase Clear Gloss Coating KB65C2000 Kit
Apply per manufacturer’s written instructions. Do not spray apply.

END OF SECTION 099123

SECTION 099300 - STAINING AND TRANSPARENT FINISHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes surface preparation and the application of wood stains and transparent finishes on the following substrates:

1. Interior wood substrates, where indicated.

B. Related Sections include the following:

1. Section 064023 “Interior Architectural Woodwork” for shop-applied transparent finishes of interior cabinets and woodwork.
2. Division 08 Section(s) for shop-applied transparent finishes of wood doors.
3. Sections 099113 "Exterior Painting" and 099123 "Interior Painting" for surface preparation and application of standard paint systems.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include preparation requirements and application instructions.

B. Sustainable Design Requirements: Product data indicating printed statement of VOC content.

C. Samples for Initial Selection: For each type of product indicated.

D. Samples for Verification: For each type of finish system and in each color and gloss of finish indicated.

1. Submit Samples on representative samples of actual wood substrates, 8 inches square.
2. Label each Sample for location and application area.

E. Product List: For each product indicated, include the following:

1. Cross-reference to finish system and locations of application areas. Use same designations indicated on Drawings and in schedules.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and painter.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.

1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. of each material and color applied.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm regularly engaged in producing stain and transparent finishing products that have been used for similar applications with successful results, capable of producing paint products that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports. Manufacturer's stain and transparent finishing products shall comply with MPI standards and shall be listed in its "MPI Approved Products Lists."

B. Painter Qualifications: A painting firm with not less than 10 years' experience with work similar in material, design, and extent to that indicated for this Project and whose work has resulted in installations with a record of successful in-service performance. Painting firm shall be a member of the Painting and Decorating Contractors of America.

C. MPI Standards:

1. Products: Complying with MPI standards indicated and listed in its "MPI Approved Products List."
2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and finish systems indicated.

D. Mockups: Apply benchmark samples of each finish system indicated and each color selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each type of finish system and substrate.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft.
b. Other Items: Architect will designate items or areas required.

2. Final approval of stain color selections will be based on mockups.

a. If preliminary stain color selections are not approved, apply additional mockups of additional stain colors selected by Architect at no added cost to Owner.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

A. Apply finishes only when temperature of surfaces to be finished and ambient air temperatures are between 50 and 85 deg F.

B. Do not apply exterior finishes in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide stain products by the following:

1. Sherwin-Williams Company (SW).

B. Source Limitations: Obtain stain materials from single source from single manufacturer.

2.2 MATERIALS, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its “MPI Approved Products List.”

B. Material Compatibility:

1. Provide materials for use within each finish system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a finish system, provide products recommended in writing by manufacturers of topcoat for use in finish system and on substrate indicated.

C. VOC Content: Products shall comply with the following VOC limits.

1. Clear Wood Finishes, Varnishes: VOC not more than 275 g/L.
2. Shellacs, Clear: VOC not more than 730 g/L.
3. Stains: VOC not more than 250 g/L.
4. Primers, Sealers, and Undercoaters: 100 g/L.

D. Stain Colors and Gloss: As indicated on Drawings, or if not indicated, custom stain color to match Architect’s samples.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Maximum Moisture Content of Wood Substrates: 15 percent when measured with an electronic moisture meter.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Proceed with finish application only after unsatisfactory conditions have been corrected.

1. Beginning finish application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and finishing.

1. After completing finishing operations, reinstall items that were removed; use workers skilled in the trades involved. Remove surface-applied protection if any.

C. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each particular substrate condition and as specified.

1. Remove surface dirt, oil, or grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.

D. Apply wood filler paste to open-grain woods, as defined in "MPI Architectural Painting Specification Manual," to produce smooth, glasslike finish.

3.3 APPLICATION

A. Apply finishes according to manufacturer's written instructions and recommendation in “MPI Architectural Painting Specification Manual.”

1. Use applicators and techniques suited for finish and substrate indicated.
2. Finish surfaces behind movable equipment and furniture same as similar exposed surfaces.
3. Do not apply finishes over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

3.4 FIELD QUALITY CONTROL.

A. Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when finishes are being applied:

1. Owner may engage the services of a qualified testing agency to sample finish materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying finishes if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying materials from Project site, pay for testing, and refinish surfaces finished with rejected materials. Contractor will be required to remove rejected materials from previously finished surfaces if, on refinishing with complying materials, the two finishes are incompatible.

3.5 CLEANING AND PROTECTION

A. At end of workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing finish application, clean spattered surfaces. Remove spattered materials by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced finished wood surfaces.

3.4 WOOD-FINISH-SYSTEM SCHEDULE.

A. Interior Wood Substrates:

1. Stain, Interior, Water-Based, Semi-Transparent System:

a. Prime Coat: Stain, semi-transparent, matching topcoat.
b. Topcoat: Stain, semi-transparent, for interior/exterior wood, MPI #186.
c. MPI Green Performance Standard: GPS-1.

2. Varnish, Water-Based, Clear, Satin System:

a. Prime Coat: Water-based varnish matching topcoat.
b. Intermediate Coat: Water-based varnish matching topcoat.
c. Top Coat: Varnish, water based, clear, satin (Gloss Level 4), MPI#128.
d. MPI Green Performance Standard: GPS-1.

3. Varnish Water-Based, Clear, Gloss System:

a. Prime Coat: Water-based varnish matching topcoat.
b. Intermediate Coat: Water-based varnish matching topcoat.
c. Top Coat: Varnish, water based, clear, satin (Gloss Level 6), MPI#130.
d. MPI Green Performance Standard: GPS-1.

END OF SECTION 099300

SECTION 101419 - DIMENSIONAL LETTER SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Fabricated channel dimensional characters.
2. Illuminated, fabricated channel dimensional characters.

1.3 DEFINITIONS

A. Illuminated: Illuminated by lighting source integrally constructed as part of the sign unit.

1.4 COORDINATION

A. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For dimensional letter signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
3. Show message list, typestyles, graphic elements, and layout for each sign.
4. Show locations of electrical service connections.
5. Include diagrams for power, signal, and control wiring.
6. Shop Drawings shall be stamped and signed by the qualified California-licensed professional engineer responsible for their preparation.

C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.

1. Include representative Samples of available typestyles and graphic symbols.

D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:

1. Dimensional Characters: Full-size Sample of each type of dimensional character.
2. Exposed Accessories: Full-size Sample of each accessory type.

E. Product Schedule: For dimensional letter signs. Use same designations as indicated on Drawings or specified.

F. Delegated-Design Submittal: For signs indicated in "Performance Requirements" Article.

1. Include structural analysis calculations for signs indicated to comply with design loads; stamped and signed by the qualified California-licensed professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of dimensional letter signage that has been used for similar applications with successful results, that meets or exceeds performance requirements indicated, and of documenting this performance by inclusion in test reports.

B. Installer Qualifications: A firm with not less than 10 years' experience installing dimensional letter signage similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

1.9 FIELD CONDITIONS

A. Field Measurements: Verify locations of electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Deterioration of finishes beyond normal weathering.
b. Separation or delamination of sheet materials and components.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide dimensional letter signage by one of the following:

1. ASI Sign Systems, Inc.
2. Apco Graphics, Inc.

B. Source Limitations: Obtain dimensional letter signage from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified California-licensed professional engineer to engineer sign structure and anchorage of exterior dimensional character sign type(s) to withstand seismic, wind, and gravity design loads as indicated on Drawings.

B. Structural Performance: Signs and supporting elements shall withstand the effects of gravity and other loads within limits and under conditions indicated.

1. Uniform Wind Load: As indicated on Drawings based upon criteria in the 2016 California Building Code.
2. Seismic Loads: As indicated on Drawings based upon criteria in the 2016 California Building Code.
3. Uniform and concentrated loads need not be assumed to act concurrently.

C. Thermal Movements: For exterior fabricated channel dimensional characters, allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

D. 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.

2.3 DIMENSIONAL CHARACTERS

A. Fabricated Channel Characters: Metal face and side returns, formed free from warp and distortion; with uniform faces, sharp corners, and precisely formed lines and profiles; internally braced for stability and for securing fasteners; and as follows.

1. Illuminated Characters: Illuminated character construction with LED lighting including transformers, insulators, and other accessories for operability, with provision for servicing and concealing connections to building electrical system. Use tight or sealed joint construction to prevent unintentional light leakage. Space lamps apart from each other and away from character surfaces as needed to illuminate evenly.
    a. Power: As indicated on electrical Drawings, or if not indicated, power compatible with house power without supplemental transformers.
    b. Weeps: Provide weep holes to drain water at lowest part of exterior characters. Equip weeps with permanent baffles to block light leakage without inhibiting drainage.
2. Character Material: As indicated on Drawings.
3. Material Thickness: Manufacturer's standard for size and design of character.
4. Character Height: As indicated on Drawings.
5. Character Depth: As indicated on Drawings.
6. Finishes: As indicated on Drawings.
7. Mounting: As indicated, or if not indicated, manufacturer’s standard concealed back bar or bracket assembly.
    a. Hold characters at distance from wall surface as indicated on Drawings, or if not indicated, per manufacturer’s recommended distance from wall surface.
8. Typeface: As indicated on Drawings.

2.4 DIMENSIONAL CHARACTER MATERIALS

A. Provide alloy and temper recommended by sign manufacturer for casting process used and for type of use and finish indicated. Comply with the following reference standards as applicable:

1. Aluminum: Castings ASTM B 26; sheet and plate ASTM B 209; extrusions ASTM B 221.
2. Stainless Steel Sheet: ASTM A 240.

2.5 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:

1. Use concealed fasteners and anchors unless indicated to be exposed.
2. For exterior exposure, provide stainless steel devices unless otherwise indicated.
3. Sign Mounting Fasteners:

    a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.

B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.6 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
4. Internally brace dimensional characters for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners.
5. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

B. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted signs to suit sign construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.

1. Aluminum Brackets: Factory finish brackets with baked-enamel or powder-coat finish to match sign-background color color unless otherwise indicated.
2. Stainless-Steel Brackets: Factory finish brackets to match sign background finish unless otherwise indicated.

2.7 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.

D. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.

2.8 ALUMINUM FINISHES

A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

2.9 STAINLESS STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
2. Directional Satin Finish: No. 4.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of signage work.

B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.

C. Verify that electrical service is correctly sized and located to accommodate signs.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
3. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Mounting Methods:

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.

a. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

2. Concealed Back Bar and Brackets: Remove loose debris from substrate surface and install concealed backbar or bracket supports in position so that signage is correctly located and aligned.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed characters and signs that do not comply with specified requirements. Replace characters with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101419

SECTION 101423 - PANEL SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Panel signs.
2. Room identification signs.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for temporary Project identification signs and for temporary informational and directional signs.
2. Section 101419 "Dimensional Letter Signage" for dimensional letter signs.
3. Section 142000 "Elevators" for code-required conveying equipment signage.
4. Division 22, 23, and 26 Sections for labels, tags, and nameplates for plumbing, HVAC, and electrical systems and equipment.
5. Section 265219 "Emergency and Exit Lighting" for illuminated exit sign units.

1.3 DEFINITIONS

A. Accessible: In accordance with the accessibility standard.

1.4 COORDINATION

A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For panel signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign.

C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.

1. Include representative Samples of available typestyles and graphic symbols.

D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:

1. Panel Signs:

a. For signs 12 inches and smaller: Full-size Sample
b. For signs greater than 12 inches: Not less than 12 inches square, including corner.

2. Variable Component Materials: 8-inch Sample of each base material, character (letter, number, and graphic element) in each exposed color and finish not included in Samples above.
3. Exposed Accessories: Full-size Sample of each accessory type.
4. Full-size Samples, if approved, will be returned to Contractor for use in Project.

E. Product Schedule: For panel signs. Use same designations indicated on Drawings or specified.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For installer and manufacturer.

B. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of panel signage that has been used for similar applications with successful results, that meets or exceeds performance requirements indicated, and of documenting this performance by inclusion in test reports.

B. Installer Qualifications: A firm with not less than 5 years' experience installing panel signage similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

1.9 FIELD CONDITIONS

A. Field Measurements: Verify locations of anchorage devices in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Deterioration of finishes beyond normal weathering.
b. Deterioration of embedded graphic image.
c. Separation or delamination of sheet materials and components.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide panel signage by one of the following:

1. ASI Sign Systems, Inc.
2. Apco Graphics, Inc.
3. Or Comparable Equal, subject to Owner and Architect approval.

B. Source Limitations: Obtain dimensional letter signage from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Thermal Movements: For exterior signs and interior signs subject to direct sun contact, allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

B. Accessibility Standard: Comply with applicable provisions in the 2010 ADA Standards for Accessible Design and the accessibility requirements of the 2016 California Building Code.

2.3 PANEL AND ROOM-IDENTIFICATION SIGNS

A. Panel Sign and Room-Identification Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

1. Laminated-Sheet Sign: Photopolymer face sheet with raised graphics laminated over subsurface graphics to acrylic backing sheet to produce composite sheet. Provide tactile copy and Braille raised 1/32 inch minimum from plaque first surface by manufacturer’s photopolymer bonded process. Signface shall be of single material, with tactile characters and Braille integral to photopolymer. Adhesive-faced characters are not acceptable.

a. Composite-Sheet Thickness: Manufacturer's standard for size of sign, but no less than 0.125 inch.
b. Finish: Matte (non glare).
c. Background: Colors and pattern as indicated.
d. Tactile lettering and graphics: Colors and content as indicated.
e. Panel size: As indicated.

2. Sign-Panel Perimeter: Finish edges smooth.

a. Edge Condition: As indicated on Drawings, or if not indicated, square cut.
b. Corner Condition in Elevation: As indicated on Drawings, or if not indicated, square.

3. Mounting: Manufacturer’s standard method for substrates indicated, with concealed mechanical anchors typical, except two-face tape on glass substrates.
4. Text and Typeface: Accessible raised characters and Braille, as required per accessibility standard and as indicated on Drawings.
5. Flatness Tolerance: Sign panel shall remain flat or uniformly curved under installed conditions as indicated and within a tolerance of plus or minus 1/16 inch measured diagonally from corner to corner.

2.4 PANEL-SIGN MATERIALS

A. Aluminum Sheet and Plate: ASTM B 209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

B. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

C. Acrylic Sheet: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).

D. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.5 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following unless otherwise indicated:

1. Use concealed fasteners and anchors unless indicated to be exposed.
2. For exterior exposure, furnish stainless-steel devices unless otherwise indicated.
3. Exposed Metal-Fastener Components, General:

    a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.

4. Sign Mounting Fasteners:

    a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly unless otherwise indicated.
    b. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, and installed in predrilled holes.

B. Two-Face Tape (Glass Substrates Only): Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.6 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Preassemble signs in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
4. Internally brace signs for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners.
5. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

2.7 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.

D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.8 ALUMINUM FINISHES

A. Color Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.

B. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.

C. Verify that anchorage devices embedded in permanent construction are correctly sized and located to accommodate signs.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Install signs so they do not protrude or obstruct according to the accessibility standard.
3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Accessible Signage: Install in locations on walls as indicated on Drawings and according to the accessibility standard.

C. Mounting Methods:

1. Concealed Mechanical Fasteners: Using a template, drill holes in substrate aligning with fasteners on back of sign. Remove loose debris from hole and substrate surface.

a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
b. Thin or Hollow Surfaces: Place sign in position and flush to surface, and mechanically fasten using mounting methods recommended by sign manufacturer.

2. Two-Face Tape (Glass substrates only): Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.

D. Signs Mounted on Glass: Provide opaque sheet matching sign material and finish onto opposite side of glass to conceal back of sign.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101423

SECTION 102113 - SOLID PHENOLIC TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Compact laminate solid phenolic toilet compartments configured as toilet enclosures and urinal screens.

B. Related Requirements:

1. Section 092216 "Non-Structural Metal Framing" for blocking/ backing in gypsum board walls.
2. Section 102800 "Toilet and Shower Accessories" for accessories mounted on toilet compartments.

1.3 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that toilet compartments can be supported and installed as indicated.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.

B. Shop Drawings: Provide project-specific shop drawings for toilet compartments.

1. Include plans, elevations, sections, details, and attachment details.
2. Show locations of cutouts for compartment-mounted toilet accessories.
3. Show locations of centerlines of toilet fixtures.
4. Show locations of floor drains.

C. Samples for Initial Selection: For each type of toilet compartment material indicated.

1. Include Samples of hardware and accessories involving material and color selection.

D. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:

1. Each type of material, color, and finish required for toilet compartments, prepared on 6-inch-square Samples of same thickness and material indicated for Work.
2. Each type of hardware and accessory.

E. Product Schedule: For toilet compartments, prepared by or under the supervision of supplier, detailing location and selected colors for toilet compartment material.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Product Certificates: For each type of toilet compartment.

C. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of solid phenolic toilet compartments that have been used for similar applications with successful results, that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports.

B. Installer Qualifications: A firm with not less than 5 years' experience installing solid phenolic toilet compartments similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

1.8 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of toilet compartments that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Faulty operation of toilet compartment partitions, hardware, or accessories.
b. Deterioration of finishes, and other materials beyond normal wear.

2. Warranty Period: Minimum 25 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide solid phenolic toilet compartments by the following:

1. Bobrick Washroom Equipment, Inc.; DuraLine Series (2080/2180 Series).

B. Source Limitations: Obtain solid phenolic toilet compartments from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 75 or less.
2. Smoke-Developed Index: 450 or less.

B. Regulatory Requirements: Comply with applicable provisions in the 2010 ADA Standards for Accessible Design and the accessibility requirements of the 2016 California Building Code (CBC).

C. Visual Characteristics and Product Options: Information on Drawings and in specifications establishes requirements for aesthetic effects. Aesthetic effects are indicated by colors, patterns, arrangements, alignments and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.
2. Toilet partition system shall be "European" style with zero sightlines and minimal exposed hardware.

2.3 COMPACT LAMINATE, SOLID PHENOLIC TOILET COMPARTMENTS

A. Toilet-Enclosure Style: Floor-mounted, overhead-braced, zero sightline.

B. Urinal-Screen Style: Wall hung.

C. Door, Panel, and Pilaster Construction: Solidly fused plastic laminate with matte-finish melamine surfaces; integrally bonded colored face sheets and black phenolic-resin core panel material, seamless, with eased and polished edges and no-sightline system. Provide minimum 3/4-inch-thick doors and pilasters, and 1/2-inch-thick panels and screens.

1. Height: 72 inches high, mounted minimum 9 inches above finished floor, complying with accessibility requirement for toe clearance (CBC 11B-604.8.1.4).
2. Surface Color and Pattern: As indicated on Drawings, or if not indicated, as selected by Architect from manufacturer's standard and optional colors, patterns, and textures.

    a. Edge Color: Black.

D. Stiles: Floor-anchored stiles furnished with expansion shields and threaded rods.

1. Leveling Devices: 7 gauge, 3/16 inches thick, corrosion-resistant, chromate-treated, double zinc-plated steel angle leveling bar bolted to stile; furnished with 3/8 inch diameter threaded rods, hex nuts, lock washers, flat washers, spacer sleeves, expansion anchors, and shoe retainers.
2. Stile Shoes: One-piece, 22 gauge, 18-8, Type 304 stainless steel, 4 inch height; tops with 90 degree return to stile. One-piece shoe capable of adapting to 3/4 inch or 1 inch stile thickness and capable of being fastened (by clip) to stiles starting at wall line.

E. Brackets (Fittings): Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.

F. Anchors: Expansion shields and threaded rods at floor connections as applicable.

2.4 HARDWARE AND ACCESSORIES

A. Hardware and Accessories: Manufacturer's heavy-duty operating hardware and accessories.

1. Compliance: Operating force of less than 5 lb.
2. Emergency Access: Hinges, latch allow door to be lifted over keeper from outside compartment on inswing doors.
3. Materials: 18-8, Type 304, heavy-gauge stainless steel with satin finish.
4. Doorstops: Prevents inswinging doors from swinging out beyond stile; on outswing doors, doorstop prevents door from swinging in beyond stile.

5. Fastening: Hardware secured to door and stile by through-bolted, theft-resistant, pin-in-head Torx stainless steel machine screws into factory-installed, threaded brass inserts. Fasteners secured directly into core not acceptable.

    a. Threaded Brass Inserts: Factory-installed; withstand direct pull force exceeding 1500 lb per insert.

6. Clothes Hooks: Projecting no more than 1-1/8 inch (29 mm) from face of door.
7. Door Hardware Type:

    a. Institutional Hardware

        1) Latching: 14 gauge sliding door latch, 11 gauge keeper; latch slides on a shock-resistant nylon track.
        2) Hinges: 16 gauge stainless steel, self-closing, 3 section hinges.

8. Fittings:

    a. Institutional Hardware

        1) Mounting Brackets: 18 gauge stainless steel and extend full height of panel.
        2) U-Channels: Secure panels to stiles.
        3) Angle Brackets: Secure stiles-to-walls and panels to walls.

B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless-steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel compatible with related materials.

2.5 MATERIALS

A. Aluminum Castings: ASTM B 26.

B. Aluminum Extrusions: ASTM B 221.

C. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.

D. Stainless-Steel Castings: ASTM A 743.

E. Zamac: ASTM B 86, commercial zinc-alloy die castings.

2.6 FABRICATION

A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.

B. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

C. Door Size and Swings: Unless otherwise indicated, provide 24-inch-wide in-swinging doors for standard toilet compartments and 36-inch-wide out-swinging doors with a minimum 32-inch-wide clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.

1. Confirm location and adequacy of blocking and supports required for installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.

a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
b. Align brackets at pilasters with brackets at walls

B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.

C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.3 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 102113

SECTION 102239 - OPERABLE PANEL PARTITIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes manually operated, acoustical panel partitions.

B. Related Requirements:

1. Section 035416 "Hydraulic Cement Underlayment" for cement underlayment material for floor substrates which are not in compliance with the floor tolerance requirements of the operable wall manufacturer's written instructions.
2. Section 051200 "Structural Steel Framing" and/or Section 055000 "Metal Fabrications" for supports that attach supporting tracks to overhead structural system.
3. Section 092900 "Gypsum Board" for sound barrier construction above the ceiling at track.

1.3 DEFINITIONS

A. NIC: Noise Isolation Class.

B. STC: Sound Transmission Class.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 COORDINATION

A. Coordinate with adjacent trades to meet the following site tolerances required by the operable wall manufacturer:

1. The floor underneath the operable wall along its axis, shall be flat to within +/- 1/4 inch over the entire length of an operable wall. The peak to valley undulation of +/- 1/4 inch shall not be closer together than 24" and a peak to valley undulation of +/- 1/8" shall not be closer than 12".
2. Support steel above the operable wall along its axis shall be parallel to the floor within +/- 1/2 inch for the entire length of the operable wall. This includes loaded deflection. The beam must also be parallel to the center line of the wall within + 1/8", left to right.
3. The fixed walls at either end of the operable wall shall be within +1/4 inch, -0 inches, from plumb vertical.
4. The fixed walls at either end of the operable wall shall be flat to within +0 inches, -1/4 inch.
5. All floor and/or roof dead load material construction must be completed prior to installation of Work under this Section.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: Product data indicating compliance with sustainable design performance requirements.

C. Shop Drawings: Provide project-specific shop drawings for operable panel partitions.

1. Include plans, elevations, sections, details, numbered panel installation sequence, and attachments to other work.
2. Indicate stacking and operating clearances. Indicate location and installation requirements for hardware and track, blocking, and direction of travel.

D. Samples for Initial Selection: For each type of exposed material, finish, covering, or facing.

1. Include Samples of accessories involving color selection.

E. Samples for Verification: For each type of exposed material, finish, covering, or facing, prepared on Samples of size indicated below:

1. Panel Facing Material: Manufacturer's standard-size unit, not less than 3 inches square.
2. Panel Edge Material: Not less than 3 inches long.
3. Hardware: One of each exposed door-operating device.

1.7 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Partition track, track supports and bracing, switches, turning space, and storage layout.
2. Suspended ceiling components.
3. Structural members to which suspension systems are attached.
4. Size and location of initial access modules for acoustical tile.
5. Bulkheads.
6. Items penetrating finished ceiling, including the following:

a. Lighting fixtures.
b. HVAC ductwork, outlets, and inlets.
c. Speakers.
d. Sprinklers.
e. Smoke detectors.
f. Access panels.
g. Security components.

B. Setting Drawings: For embedded items and cutouts required in other work, including support-beam, mounting-hole template.

C. Qualification Data: For qualified manufacturer, installer, and testing agency.

D. Product Certificates: For each type of operable panel partition.

E. Seismic Qualification Certificates: For operable panel partitions, tracks, accessories, and components, from manufacturer. Include seismic capacity of partition assemblies to remain in vertical position during a seismic event and the following:

1. Basis for Certification: Indicate whether certification is based on analysis, testing, or experience data, according to ASCE/SEI 7.
2. Detailed description of partition anchorage devices on which the certification is based and their installation requirements.

F. Product Test Reports: For each operable panel partition, for tests performed by a qualified testing agency.

G. Acoustical Test Reports: Submit reports of tests conducted by an independent accredited acoustical laboratory showing acoustical performance (STC, NIC, and NRC ratings) achieved in laboratory and field tests as follows:

1. STC Rating: Submit laboratory test data showing that a fully operating installation of each specific type of panel assembly has been tested in accordance with ASTM E 90-09 and has met or exceeded the specified Sound Transmission Class (STC) rating.
2. NIC Rating: Submit field test data showing that up to five comparable installations of each specific type of partition have been tested in accordance with ASTM E 336-97 (NIC-42) or ASTM E 336-05 (NIC-40) and have met or exceeded the specified Noise Isolation Class (NIC) rating.

H. Field quality-control reports.

I. Sample Warranty: For manufacturer's special warranty.

1.8 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For operable panel partitions to include in maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Panel finish facings and finishes for exposed trim and accessories. Include precautions for cleaning materials and methods that could be detrimental to finishes and performance.
b. Seals, hardware, track, track switches, carriers, and other operating components.

1.9 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same production run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Panel Finish-Facing Material: Furnish full width in quantity to cover both sides of two panels when installed.

1.10 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of operable panel partition systems that have been used for similar applications with successful results, that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports, labels, and calculations. Manufacturer shall have factory-authorized service representatives who are available for consultation, periodic Project-site observations, and on-site assistance.

B. Installer Qualifications: A firm with not less than 10 years' experience installing operable panel partitions similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

C. Acoustical Testing: Operable partition acoustical performance criteria shall be determined according to the following requirements:

1. Laboratory STC tests shall be performed in accordance with ASTM E 90-09 by an independent NVLAP approved testing laboratory. Tests of panels with pass doors will be included, if pass doors are included in this work.
2. Field NIC tests shall have been conducted on partitions and in spaces whose sizes are as similar as possible to conditions on this Project. Field tests shall have been conducted on up to five different projects. Field tests submitted shall have utilized broad band noise signal sources, instrumentation and techniques in accordance with ASTM E 336-97 or ASTM E 336-05 and E 413-10. Receiving room sound measurements shall have been taken at no greater than 10' from partitions.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Protectively package and sequence panels in order for installation. Clearly mark packages and panels with numbering system used on Shop Drawings. Do not use permanent markings on panels.

1.12 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of operable panel partitions that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Faulty operation of operable panel partitions.
b. Deterioration of metals, metal finishes, and other materials beyond normal use.
c. Failure to meet acoustic performance requirements.

2. Warranty Period:

a. Partitions: 4 years from date of Substantial Completion.
b. Suspension System: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of Design Manufacturer and Products: Subject to compliance with requirements, provide operable panel partitions by the following:

1. Hufcor Inc.;

a. Series 641.
b. Series GA1 Ultra Acoustical Glass Wall, Omni Panels 45-46 STC.

B. Source Limitations: Obtain operable panel partitions from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General: Operable panel partitions shall comply with the 2016 California Building Code.

B. Seismic Performance: Operable panel partitions shall withstand the effects of earthquake motions determined according to the 2016 California Building Code and ASCE/SEI 7.

1. The term "withstand" means "the partition panels will remain in place without separation of any parts from the system when subjected to the seismic forces specified.

C. Acoustical Performance: Provide operable panel partitions tested by a qualified testing agency for the following acoustical properties according to test methods indicated:

1. Sound-Transmission Requirements: Operable panel partition assembly tested for laboratory sound-transmission loss performance according to ASTM E 90, determined by ASTM E 413, and rated for not less than STC 53 as necessary to achieve a minimum field NIC as specified below.
2. Noise-Isolation Requirements: Installed operable panel partition assembly, identical to partition tested for STC, tested for NIC according to ASTM E 336, determined by ASTM E 413, and not less than NIC 40-42.

D. Fire-Test-Response Characteristics: Provide panels with finishes complying with one of the following as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Surface-Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

a. Textile and vinyl wall coverings:

1) Flame-Spread Index: 25 or less.
2) Smoke-Developed Index: 450 or less.

b. Other materials with a thickness greater than 0.036 inch:

1) Flame Spread Index: 76-200.
2) Smoke Developed Index: 450 or less.

2. Fire Growth Contribution: Complying with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265 Method B Protocol or NFPA 286.

E. Sustainable Design Performance: Composite wood products shall comply with the following:

1. Composite Wood Products: Hardwood plywood and medium density fiberboard composite wood products used on the interior or exterior of the building shall meet the requirements for formaldehyde as specified in ARB's Air Toxics Control Measure (ATCM) for Composite Wood (17 CCR 93120 et seq.) Those materials not exempted under the ATCM must meet the specified emission limits, as shown in 2016 CALGreen Table 5.504.4.5.

2.3 OPERABLE ACOUSTICAL PANELS

A. Operable Acoustical Panels: Partition system, including panels, seals, finish facing, suspension system, operators, and accessories.

B. Panel Operation: Manually operated, individual panels.

C. Panel Construction: As required to support panel from suspension components and with reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.

D. Dimensions: Fabricate operable acoustical panel partitions to form an assembled system of dimensions indicated and verified by field measurements.

1. Panel Width: Equal widths.

a. Size panels to maximize number of panels that will fit into storage pocket indicated.

E. Panel Thickness: Not less than 4 inches.

F. Panel Materials:

1. Panel faces shall be laminated to appropriate substrate to meet the STC performance requirement. Substrate materials include:

a. Steel Frame: Steel sheet, in thickness required to meet performance requirements, but no less than nominal 16 gauge thickness for uncoated steel.
b. Steel Face/Liner Sheets: Tension-leveled steel sheet, in thickness required to meet performance requirements.
c. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use, corrosion resistance, and finish indicated; ASTM B 221 for extrusions; manufacturer's standard strengths and thicknesses for type of use.
d. Frame Reinforcement: Manufacturer's standard steel or aluminum.
e. Any composite materials used to achieve the STC rating shall be made with binder containing no urea formaldehyde.

G. Glass and Glazing:

1. Safety Glass Standard for Partition Panels: Glass products complying with testing requirements in 16 CFR 1201, Category II, or ANSI Z97.1, Class A.
2. Safety Glass Standard for Pass Doors: Glass products complying with testing requirements in 16 CFR 1201, Category II.
3. Glass: Manufacturer's standard safety glass and glass assemblies as indicated and complying with the following:

    a. The glass shall be of factory installed nom. 2 inch dual laminated insulated glass unit. For heights 10 feet and over, a horizontal panel splice is required for two glass units.
    b. Tempered Glass: ASTM C 1048, Kind FT (fully tempered), Type I (transparent flat glass), Class 1 (clear), Quality-Q3.
    c. Laminated Glass: ASTM C 1172, with clear interlayer.
    d. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass as indicated, separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.
    e. Glazing System: Manufacturer's standard factory-glazing system.

H. Panel Closure: Manufacturer's standard unless otherwise indicated.

1. Initial Closure: Flexible, resilient PVC, bulb-shaped acoustical seal.
2. Final Closure: Constant-force, lever-operated mechanical closure expanding from panel edge to create a constant-pressure acoustical seal.

I. Hardware: Manufacturer's standard as required to operate operable panel partition and accessories; with decorative, protective finish.

J. Operation:

1. Panels are manually moved from the storage area, positioned in the opening, and seals set.
2. Retractable Horizontal Seals: Retractable horizontal seals shall be activated by a quick-set operating handle located approximately 42 inches from the floor in the panel edge. Top and bottom retractable seals on each panel shall be operated simultaneously.
3. Automatic Floor Seals: Horizontal seals shall be activated by pressing the edge of the panel into the edge of the adjacent panel or wall.

K. Finish Facing: As indicated on Drawings, or if not indicated, as selected by Architect from manufacturer's full range of standard and optional finishes.

2.4 SEALS

A. Description: Seals that produce operable panel partitions complying with performance requirements and the following:

1. Manufacturer's standard seals unless otherwise indicated.
2. Seals made from materials and in profiles that minimize sound leakage.
3. Seals fitting tight at contact surfaces and sealing continuously between adjacent panels and between operable panel partition perimeter and adjacent surfaces, when operable panel partition is extended and closed.

B. Vertical Seals: Deep-nesting, interlocking astragals mounted on each edge of panel, with continuous PVC acoustical seal.

C. Horizontal Top Seals: Continuous-contact, extruded-PVC seal exerting uniform constant pressure on track.

D. Horizontal Bottom Seals: PVC-faced, mechanical, retractable, constant-force-contact seal exerting uniform constant pressure on floor when extended, ensuring horizontal and vertical sealing and resisting panel movement.

1. Mechanically Operated for Acoustical Panels: Extension and retraction of bottom seal by operating handle or built-in operating mechanism, with operating range not less than 2 inches between retracted seal and floor finish.

2.5 PANEL FINISH FACINGS

A. General: Provide finish facings for panels that comply with indicated fire-test-response characteristics and that are factory applied to operable panel partitions with appropriate backing, using mildew-resistant nonstaining adhesive as recommended by facing manufacturer's written instructions.

1. Apply one-piece, seamless facings free of air bubbles, wrinkles, blisters, and other defects, with no gaps or overlaps. Horizontal seams are not permitted. Tightly secure and conceal raw and selvage edges of facing for finished appearance.
2. Where facings with directional or repeating patterns or directional weave are indicated, mark facing top and attach facing in same direction.
3. Match facing pattern 72 inches above finished floor.

B. High-Performance Woven Fabric Wall Covering: Manufacturer's standard woven fabric, from same dye lot, treated to resist stains.

1. Color/Pattern: As indicated on Drawings, or if not indicated, custom to match Architect's sample.

C. High-Pressure Decorative Laminate: NEMA LD 3, Horizontal grade.

1. Color/Pattern: As indicated on Drawings, or if not indicated, as selected by Architect.

D. Cap-Trimmed Edges: Protective perimeter-edge trim with tight hairline joints concealing edges of panel and finish facing, finished as follows:

1. Color: As selected by Architect from manufacturer’s standard colors.

2.6 SUSPENSION SYSTEMS

A. Tracks: Steel or aluminum with adjustable steel hanger rods for overhead support, designed for operation, size, and weight of operable panel partition indicated. Size track to support partition operation and storage without damage to suspension system, operable panel partitions, or adjacent construction. Limit track deflection to no more than 0.10 inch between bracket supports. Provide a continuous system of track sections and accessories to accommodate configuration and layout indicated for partition operation and storage.

1. Panel Guide: Aluminum guide on both sides of the track to facilitate straightening of the panels; finished with factory-applied, decorative, protective finish.
2. Head Closure Trim: As required for acoustical performance; with factory-applied, decorative, protective finish.

B. Carriers: Trolley system as required for configuration type, size, and weight of partition and for easy operation; with ball-bearing wheels.

1. Multidirectional Carriers: Capable of negotiating intersections without track switches.
2. Each panel shall be supported by two 2-wheeled counter-rotating horizontal carriers. Wheel shall be of precision ground steel ball bearings with heat treated and hardened races encased with molded polymer tires. Include optional assemblies for weight of panels.

C. Track Intersections, Switches, and Accessories: As required for operation, storage, track configuration, and layout indicated for operable panel partitions, and compatible with partition assembly specified. Fabricate track intersections and switches from steel or aluminum.

1. Curve-and-Diverter Switches: Allow radius turns to divert panels to an auxiliary track.
2. L Intersections: Allow panels to change 90 degrees in direction of travel.
3. T Intersections: Allow panels to pass through or change 90 degrees to another direction of travel.
4. X Intersections: Allow panels to pass through or change travel direction full circle in 90-degree increments, and allow one partition to cross track of another.
5. Multidirectional Switches: Adjustable switch configuring track into L, T, or X intersections and allowing panels to be moved in all pass-through, 90-degree change, and cross-over travel direction combinations.
6. Center carrier stop.

D. Aluminum Finish: Mill finish or manufacturer's standard, factory-applied, decorative finish unless otherwise indicated.

2.7 ACCESSORIES

A. Storage Pocket Door: Full height at end of partition runs to conceal stacked partition; of same materials, finish, construction, thickness, and acoustical qualities as panels; complete with operating hardware. Hinges in finish to match other exposed hardware.

1. Manufacturer's standard method to secure storage pocket door in closed position.
2. Rim Lock: Key-operated lock cylinder, keyed to master key system, to secure storage pocket door in closed position. Include two keys per lock.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable panel partitions.

1. Confirm work above operable partition has been completed prior to installation of Work under this Section which may result in dead load deflections.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Comply with ASTM E 557 except as otherwise required by operable panel partition manufacturer's written installation instructions.

B. Install operable panel partitions and accessories after other finishing operations, including painting, have been completed in area of partition installation.

C. Install panels from marked packages in numbered sequence indicated on Shop Drawings.

D. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.

E. Broken, cracked, deformed, or unmatched gasketing or gasketing with gaps at butted ends is not acceptable.

F. Light-Leakage Test: Illuminate one side of partition installation and observe vertical joints and top and bottom seals for voids. Adjust partitions for alignment and full closure of vertical joints and full closure along top and bottom seals.

3.3 FIELD QUALITY CONTROL (BY CONTRACTOR)

A. Manufacturer’s Field Services: Manufacturer’s technical representative shall provide technical assistance and guidance for preparation and installation of operable panel partitions. At a minimum, arrange for manufacturer’s technical representative to observe installation of track assembly, installation of panels, and proper operation of panels. Provide additional field observation as required to obtain warranty specified and when requested by Architect, Owner or General Contractor. After each field visit, submit manufacturer’s written report of observations within 3 working days. The report shall not overall quality of work, deficiencies, and any other concerns, and recommend corrective action.

B. Final Operable Panel Partition Installation: Arrange for operable panel partition manufacturer’s technical personnel to inspect operable panel partition installation upon completion.

C. Field Acoustical Verification Tests:

1. General: Contractor shall test operable partitions for field acoustical performance within 60 days after the completion of installation. Field acoustical performance shall be determined by the measurement of Noise Reduction (NR) and the calculation of the resulting Noise Isolation Class (NIC) of all partitions.
2. Testing Agency: Field acoustical performance measurements shall be conducted on site by an independent acoustical consultant from a member firm of the National Council of Acoustical Consultants (NCAC). Testing shall be conducted or supervised by a firm approved by the project architect.
3. Scheduling and Test Sequence: After installations of operable partitions have been completed to the satisfaction of the manufacturer or his designated representative, the partitions shall be set up by the manufacturer or his representative and then field tested by the independent acoustical consultant. Prior to testing the operable partitions, the acoustical consultant shall determine whether sound flanking paths exist in surrounding building construction. All flanking paths resulting from improper construction shall be eliminated by the Contractor before testing. The Contractor and the manufacturer or his representative shall be on hand to observe the field-testing, correct flanking paths, and make product adjustments as required.
4. Testing and Reporting Procedures: Noise reduction testing shall be made in conformance with latest ASTM E 336 with receiving room sound measurements made at no greater than 10' from the partitions. NIC ratings shall be calculated in accordance with ASTM E 413-10. The results of the test(s) shall be summarized in a report that conforms with latest ASTM E 336.
5. Determining Contract Compliance: Partitions shall meet or exceed NIC ratings specified above. If partitions fail to achieve the specified NIC requirement, they shall be adjusted, corrected, or replaced and retested until they meet it. All such work shall be at no cost to the Owner.

D. If test results or inspections show operable panel partitions do not comply with requirements, remove and replace or repair operable panel partition system as recommended in writing by manufacturer, and make further repairs after retesting and inspecting until the operable panel partition system passes.

E. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust operable panel partitions, hardware, and other moving parts to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust storage pocket doors to operate smoothly and easily, without binding or warping.

C. Verify that safety devices are properly functioning.

3.5 MAINTENANCE SERVICE

A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by manufacturer's authorized service representative. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operable-partition operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain operable panel partitions.

END OF SECTION 102239

SECTION 102600 - WALL PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Corner guards.
2. Abuse-resistant wall coverings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For each type of wall protection showing locations and extent.

1. Include plans, elevations, sections, and attachment details.

C. Samples for Verification: For each type of exposed finish on the following products, prepared on Samples of size indicated below:

1. Corner Guards: 12 inches long.
2. Abuse-Resistant Wall Covering: 6 inches square.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of wall protection product to include in maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store wall protection in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

B. Regulatory Requirements: Comply with applicable provisions in the 2010 ADA Standards for Accessible Design and the accessibility requirements of the 2016 California Building Code.

2.2 MANUFACTURERS

A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide products by the following:

1. As indicated on Drawings.

Or if not indicated, by one of the following:

2. Construction Specialties; Acrovyn Corner Guards.
3. Inpro Corporation.
4. Pawling Corporation.

B. Source Limitations: Obtain wall-protection products from single source from single manufacturer.

2.3 CORNER GUARDS

A. Surface-Mounted, Metal Corner Guards: Fabricated as one piece from formed metal with formed edges; with 90- or 135-degree turn to match wall condition.

1. Material: Stainless-steel sheet, Type 304.

a. Thickness: Minimum 0.0625 inch.
b. Finish: Directional satin, No. 4.

2. Wing Size: As indicated on Drawings, or if not indicated, minimum 1-1/2 by 1-1/2 inches.
3. Height: As indicated on Drawings, or if not indicated, nominal 4 feet high.
4. Mounting: Flat-head, countersunk screws through factory-drilled mounting holes.

2.4 ABUSE-RESISTANT WALL COVERINGS

A. Abuse-Resistant Sheet Wall Covering: Fabricated from diamond-plate aluminum sheet wall-covering material.

1. Size: 48 by 96 inches for sheet, in locations indicated on Drawings.
2. Sheet Thickness: As indicated, or if not indicated, 0.125 inch.
3. Color and Texture: Manufacturer’s bright aluminum finish, diamond/checker plate texture.
4. Height: Wainscot height indicated on Drawings, or if not indicated, nominal 4 feet high.
5. Mounting: Mechanically fastened and adhered.
6. Options: Provide manufacturer's accessories: Inside corner, outside corner, high-impact top cap.

2.5 MATERIALS

A. Stainless-Steel Sheet: ASTM A 240 or ASTM A 666, Type 304, dead soft, fully annealed, with smooth surface.

B. Aluminum Sheet: ASTM B 209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

C. Fasteners: Stainless-steel fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.

2.6 FABRICATION

A. Fabricate wall protection according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.

B. Factory Assembly: Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.

C. Quality: Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

2.7 FINISHES

A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine walls to which wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Complete finishing operations, including painting, before installing wall protection.

B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

A. Installation Quality: Install wall protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

B. Accessories: Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a complete installation.

1. Provide anchoring devices and suitable locations to withstand imposed loads.
2. Adjust end and top caps as required to ensure tight seams.

C. Abuse-Resistant Wall Covering: Install abuse-resistant wall covering in accordance with manufacture’s written instructions.

3.4 CLEANING

A. Immediately after completion of installation, clean wall protection products with cleaning agent recommended by manufacturer.

B. Remove deleterious materials using methods recommended in writing by manufacturer.

END OF SECTION 102600

SECTION 102800 - TOILET AND SHOWER ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.
2. Public-use shower room accessories.
3. Underlavatory guards.
4. Hand air dryers.
5. Childcare accessories.
6. Custodial accessories.

B. Related Requirements:

1. Section 092216 "Non-Structural Metal Framing" for backing and blocking materials.
2. Section 088300 “Mirrors” for frameless mirrors.

1.3 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

C. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that toilet and shower accessories can be supported and installed as indicated.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify accessories using designations indicated.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For installer.

B. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For accessories to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A firm with not less than 5 years' experience installing toilet and shower accessories similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

1.8 WARRANTY

A. Manufacturer's Special Warranty for Hand Air Dryer: Manufacturer agrees to repair or replace hand air dryers that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

C. Accessibility Requirements: Comply with applicable provisions in the 2010 ADA Standards for Accessible Design and the accessibility requirements of the 2016 California Building Code (CBC) for toilet compartments identified as accessible.

1. Accessible toilet accessories shall be mounted at heights and at horizontal locations according to CBC.
2. Toilet paper dispensers and feminine napkin disposal units located on the grab bar side of an accessible toilet room or stall shall not project more than 3-inches from the finished wall surface nor be located closer than 1-1/2-inch clear of the tangent point of the grab bar.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

A. Basis-of-Design Manufacturer and Products: Subject to compliance with requirements, provide the following:

1. As indicated on Drawings.

B. Source Limitations: Obtain public-use washroom accessories from single source from single manufacturer.

2.3 PUBLIC-USE SHOWER ROOM ACCESSORIES

A. Basis-of-Design Manufacturer and Products: Subject to compliance with requirements, provide the following:

1. As indicated on Drawings.

B. Source Limitations: Obtain public-use shower room accessories from single source from single manufacturer.

2.4 UNDERLAVATORY GUARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Plumberex Specialty Products, Inc.
2. Truebro by IPS Corporation.
3. Or Equal.

B. Underlavatory Guard:

1. Description: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.
2. Material and Finish: Antimicrobial, molded plastic, in color as indicated on Drawings, or if not indicated, white.

2.5 HAND AIR DRYERS

A. Basis-of-Design Manufacturer and Products: Subject to compliance with requirements, provide the following:

1. As indicated on Drawings.

B. Source Limitations: Obtain hand air dryers from single source from single manufacturer.

2.6 CHILDCARE ACCESSORIES

A. Basis-of-Design Manufacturer and Products: Subject to compliance with requirements, provide the following:

1. As indicated on Drawings.

B. Source Limitations: Obtain childcare accessories from single source from single manufacturer

2.7 CUSTODIAL ACCESSORIES

A. Basis-of-Design Manufacturer and Products: Subject to compliance with requirements, provide the following:

1. As indicated on Drawings.

B. Source Limitations: Obtain custodial accessories from single source from single manufacturer.

2.8 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.

B. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

2.9 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Provide backing/blocking where basic substrate is not sufficient to support accessory without additional material.

C. Toilet accessories adjacent to grab bars shall be mounted in compliance with CBC Section 11B-609.3 and Figure 11B-609.3. Accessories that infringe on these required clearances will be rejected and reinstalled.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written instructions.

END OF SECTION 102800

SECTION 104413 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes fire-protection cabinets for portable fire extinguishers.

B. Related Requirements:

1. Section 104416 "Fire Extinguishers."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed- or semirecessed-mounting method and relationships of box and trim to surrounding construction.

B. Shop Drawings: For fire-protection cabinets. Include plans, elevations, sections, details, and attachments to other work.

C. Samples for Verification: For each type of exposed finish required, prepared on Samples 6 by 6 inches square.

D. Product Schedule: For fire-protection cabinets. Indicate whether recessed or semirecessed mounted. Coordinate final fire-protection cabinet schedule with fire-extinguisher schedule to ensure proper fit and function.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of fire protection cabinets that have been used for similar applications with successful results, that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports.

B. Installer Qualifications: A firm experienced with installing fire protection cabinets similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.7 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

B. Extinguisher Installation: Life safety cabinets shall be installed in compliance with the 2016 California Fire Code, including, but not limited to, Section 906.9.

C. Accessibility Requirements: Fire extinguishers and mounting brackets along an accessible route shall be installed in compliance with the accessibility requirements of the 2016 California Building Code and with the 2010 ADA Standards for Accessible Design including, but not limited to, Sections 308 and 309.

2.2 FIRE-PROTECTION CABINET

A. Cabinet Type: Suitable for fire extinguisher.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. JL Industries, Inc.; a division of the Activar Construction Products Group.
b. Larsens Manufacturing Company.
c. Potter Roemer LLC.

B. Cabinet Construction: Comply with fire-resistance rating of wall construction.

1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.043-inch-thick cold-rolled steel sheet lined with minimum 5/8-inch-thick fire-barrier material. Provide factory-drilled mounting holes.

C. Cabinet Material: Stainless-steel sheet.

D. Recessed Cabinet:

1. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).

E. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).

1. Square-Edge Trim: 1-1/4- to 1-1/2-inch backbend depth.

F. Cabinet Trim Material: Same material and finish as door.

G. Door Material: Stainless-steel sheet.

H. Door Style: Vertical duo panel with frame.

I. Door Glazing: Tempered float glass (clear).

J. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide projecting lever handle with cam-action latch.
2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.

K. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.

    a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."

        1) Location: Applied to cabinet door.
        2) Application Process: Silk-screened. (Press-on or vinyl letters are NOT acceptable.)
        3) Lettering Color: Red.
        4) Orientation: Vertical.

L. Materials:

1. Stainless Steel: ASTM A 666, Type 304.

    a. Finish: No. 4 directional satin finish.

2. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.3 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.
2. Provide factory-drilled mounting holes.
3. Prepare doors and frames to receive locks.
4. Install door locks at factory.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.

1. Fabricate door frames of one-piece construction with edges flanged.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.4 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for cabinets to verify actual locations before cabinet installation.

B. Examine walls and partitions for suitable framing depth and blocking where recessed and semirecessed cabinets will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for recessed and semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction and complying with accessibility requirements:

1. Units that are recessed or project less than 4 inches from wall: 54 inches above finished floor to top of cabinet.
2. Units that are surface mounted or project more than 4 inches from wall:

    a. Top of cabinet shall be no higher than 54 inches above finished floor.
    b. Bottom of cabinet shall be no higher than 27 inches above finished floor.

B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.

1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is inadequate for recessed cabinets, provide semirecessed fire-protection cabinets.
2. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.

E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104413

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Portable, hand-carried fire extinguishers.
2. Mounting brackets for fire extinguishers, in back-of-house rooms and spaces only.

B. Related Sections:

1. Section 104413 "Fire Protection Cabinets" for cabinets for fire extinguisher tanks.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

B. Product Schedule: For fire extinguishers. Coordinate final fire extinguisher schedule with fire protection cabinet schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of fire extinguishers that have been used for similar applications with successful results, that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports.

1.7 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard or customized warranty in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure of hydrostatic test according to NFPA 10.
b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1. Provide fire extinguishers approved, listed, and labeled by FM Global.

C. Extinguisher Installation: Fire extinguishers and mounting brackets shall be installed in compliance with the 2016 California Fire Code, including, but not limited to, Section 906.9.

D. Accessibility Requirements: Fire extinguishers and mounting brackets along an accessible route shall be installed in compliance with the accessibility requirements of the 2016 California Building Code and with the 2010 ADA Standards for Accessible Design including, but not limited to, Sections 308 and 309.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. J. L. Industries, Inc.; a division of Activar Construction Products Group.
2. Larsen's Manufacturing Company.
3. Potter Roemer LLC.

B. Source Limitations: Provide fire extinguishers from single source from single manufacturer.

2.3 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire protection cabinet and mounting bracket indicated.

1. Valves: Manufacturer's standard.
2. Handles and Levers: Manufacturer's standard.
3. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.

B. Multipurpose Dry-Chemical Type: UL-rated nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.

1. Type A – All Areas, Unless Noted Otherwise:

a. UL Rating: 2A-10BC.
b. Capacity: 5 pounds.
c. Finish: Red Enamel
d. Mounting: In fire protection cabinets, or wall mounted bracket.

2. Type B – Mechanical Rooms, Electrical Rooms, and Fire Pump Rooms:

a. UL Rating: 4A-60BC.
b. Capacity: 10 pounds.
c. Finish: Red Enamel
Mounting: Wall mounted bracket.

C. Wet-Chemical Type: UL-rated nominal capacity, with potassium acetate, potassium citrate, or potassium bicarbonate-based wet chemical in manufacturer's standard enameled container.

1. Type K – Commercial Kitchen:

a. UL Rating: 2A-K.
b. Capacity: 24 pounds.
c. Finish: Stainless steel.
Mounting: Wall mounted bracket.

2.4 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

1. Mounting Brackets:

a. Units that are recessed or project less than 4 inches from wall: 48 inches above finished floor to top of fire extinguisher.
b. Units that are surface mounted or project more than 4 inches from wall along an accessible route:

1) Top of fire extinguisher shall be no higher than 48 inches above finished floor.
2) Bottom of fire extinguisher shall be no higher than 27 inches above finished floor.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 104416

SECTION 105126 - SOLID PHENOLIC LOCKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes solid phenolic lockers and benches.

B. Related Requirements:

1. Section 092216 "Non-Structural Metal Framing" for backing in gypsum board walls.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of solid phenolic locker.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of locker and bench.

B. Shop Drawings: For solid phenolic lockers.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Show details full size.
3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
4. Show locations and sizes of cutouts and holes for items installed in lockers.
5. Show locker fillers, trim, base, sloping tops, and accessories.
6. Show locker numbering sequence.

C. Samples for Initial Selection: For each type of phenolic panels.

D. Samples for Verification: For the following products, in manufacturer’s standard sizes:

1. Phenolic panels, not less than 8 by 10 inches, for each type, color, pattern, and surface finish.
2. Exposed hardware and accessories, one unit for each type and finish.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Product Certificates: For each type of solid phenolic lockers.

C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of solid phenolic lockers that have been used for similar applications with successful results, that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports.

B. Installer Qualifications: A firm with not less than 5 years' experience installing solid phenolic lockers similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver lockers until painting and similar operations that could damage lockers have been completed in installation areas. If lockers must be stored in other-than-installation areas, store only in areas where environmental conditions are the same as those in final installation location, and comply with requirements specified in "Field Conditions" Article.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install lockers until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and humidity within range recommended by solid phenolic locker manufacturer during the remainder of the construction period.

B. Field Measurements: Where lockers are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings.

1. Locate concealed framing, blocking, and reinforcements that support lockers by field measurements before being enclosed, and indicate measurements on Shop Drawings.

C. Established Dimensions: Where lockers are indicated to fit to other construction, establish dimensions for areas where lockers are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.9 COORDINATION

A. Coordinate sizes and locations of bases for lockers.

B. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that lockers can be supported and installed as indicated.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of lockers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures.
b. Faulty operation of locks or hardware.
c. Deterioration of plastic other materials beyond normal use.

2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide solid phenolic lockers by the following:

1. Hollman, Inc.; "Solid Phenolic Lockers."

B. Source Limitations: Obtain solid phenolic lockers from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 75 or less.
2. Smoke-Developed Index: 450 or less.

B. Regulatory Requirements: Comply with applicable provisions in the 2010 ADA Standards for Accessible Design and the accessibility requirements of the 2016 California Building Code, including, but not limited to, the following:

1. At least 5 percent, but no fewer than one, lockers shall be designated as accessible.

2.3 SOLID PHENOLIC LOCKERS

A. Locker Construction: Solid phenolic panel material, not less than 3/8 inch thick, seamless, with eased edges, and with homogenous color and pattern throughout thickness of material.

1. Doors, Slope Tops, End Panels, Toe Kick Plates: 1/2 inch thick.
2. Sides, Tops, Bottoms, and Backs: 3/8 inch thick.
3. Venting: Horizontal.
4. Size and Tiers: As indicated on Drawings.

B. Locker Body: Fabricated from solid phenolic components.

C. End Panels: Match style, material, construction, and finish of solid phenolic doors.

D. Shelves: Fabricated from 3/8-inch thick solid phenolic.

E. Corners and Filler Panels: Minimum 3/8-inch-thick panels. Match style, material, construction, and finish of solid phenolic doors.

F. Locker Base: 4-inch high black base, 1-inch thick, field assembled.

G. Continuously Sloping Tops: Solid plastic, 3/4-inch-thick panel that matches door faces for installation over lockers with separate flat tops. Fabricate tops in lengths as long as practical, without visible fasteners at splice locations. Provide fasteners, supports, and closures, as follows:

1. Closures: Vertical-end type.
2. Sloping-top corner fillers, mitered.

H. Solid Phenolic Colors: As indicated on Drawings, or if not indicated, as selected by Architect from manufacturer's full range of standard and optional colors and textures.

2.4 HARDWARE

A. General: Provide manufacturer's standard locker hardware complying with the requirements in this Section.

B. Locker Hinges: Hinges shall be concealed and shall be made of 14 Gauge Type 304 Stainless Steel and have a Satin finish. Hinge shall have five (5) knuckles and shall allow door to open 90-degrees.

C. Locker Hasp Bar: Hasp shall be fabricated of 11 Gauge Type 304 Stainless Steel with a Satin Finish. All edges shall be polished and smooth. Hasp shall be attached to the Locker Body with two (2) Stainless Steel Theft Proof Torx Head with Pin, Through Bolts. Hasp shall extend through a slot in the face of the Locker Door and the Locker Number Plate. Locker Hasp Bar is to be used with padlocks (padlocks are not included).

D. Coat Hooks: Coat Hooks shall be fabricated of 11 Gauge Type 304 Stainless Steel with a Satin Finish. All edges shall be polished and smooth. Coat Hooks shall be attached to the Locker Body with Stainless Steel Theft Proof Torx Head with Pin fasteners or Through Bolts. Provide three (3) Coat Hooks for Single Tier Lockers and three (3) for Double Tier and “Z” Lockers. Plastic and aluminum Coat Hooks are unacceptable.

2.5 ACCESSORIES

A. Number Plates: Provide a number plate for each door or opening, in the sequence as indicated on the drawings. Number plate shall be engraved from the back side to prevent the accumulation of dirt and grime.

1. Provide ADA plaques at lockers designated as accessible.

2.6 BENCHES

A. Bench Tops: 3/4 inch thick solid phenolic with edges rounded to 1/4 inch radius, 9-1/2 inches wide by lengths as indicated on Drawings.

B. Pedestals: Stainless Steel. Bench Pedestal shall be constructed of 11 Gauge Type 304 Stainless Steel and shall be 16.5” High. Center post shall be load bearing and shall extend from the floor to the bottom of the Bench Top. Top and bottom flanges shall be welded to center post and shall be 8” in diameter. Bench Pedestals shall be secured to floor with Stainless Steel Torx Head with Pin, #14 X 2” Screws.

2.7 FABRICATION

A. Fabricate each locker with shelves, an individual door and frame, an individual top, a bottom, and a back, and with common intermediate uprights separating compartments.

1. Fabricate lockers to dimensions, profiles, and details indicated.
2. Ease edges of corners of solid-plastic members to 1/16-inch radius.

B. Fabricate lockers square, rigid, without warp, and with finished faces flat and free of scratches and chips. Accurately factory machine components for attachments. Make joints tight and true.

C. Accessible Lockers: Fabricate as follows:

1. Locate bottom shelf no lower than 15 inches above the floor.
2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches above the floor.

D. Venting: Fabricate lockers with space between doors and locker assembly of not less than 1/4 inch.

E. Number Plates: Inlay number plates flush in each locker door, near top, centered.

F. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended, and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.
2. Use only manufacturer's nuts, bolts, screws, and other devices for assembly.

G. Shop cut openings, to maximum extent possible, to receive hardware, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify that furring is attached to concrete and masonry walls that are to receive lockers.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Condition lockers to average prevailing humidity conditions in installation areas before installation.

B. Before installing lockers, examine factory-fabricated work for completeness and complete work as required, including removal of packing.

3.3 INSTALLATION

A. Install support base.

B. Assemble lockers with manufacturer's standard fasteners, with no exposed fasteners on face frames.

C. Install lockers level, plumb, and true; use concealed shims.

D. Connect groups of lockers together with manufacturer's standard fasteners, through predrilled holes, with no exposed fasteners on face frames. Fit lockers accurately together to form flush, tight, hairline joints.

E. Install lockers without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings, providing unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Installation Tolerance: No more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line. Shim as required with concealed shims.

F. Locker Anchorage: Fasten solid phenolic lockers through back, near top and bottom, at ends with No. 8 pan-head sheet metal screws through metal backing or metal framing behind wall finish and spaced not more than 16 inches o.c.

G. Scribe and cut corner and filler panels to fit adjoining work using fasteners concealed where practical. Repair damaged finish at cuts.

H. Attach sloping-top units to lockers, with end panels covering exposed ends.

I. Install number plates after lockers are in place.

1. Attach number plate on each locker door, near top, centered, with at least two screws with finish matching number plate.

J. Fixed Locker Benches: Provide no fewer than two pedestals for each bench, uniformly spaced not more than 72 inches apart. Securely fasten tops of pedestals to undersides of bench tops, and anchor bases to floor.

3.4 ADJUSTING

A. Clean, lubricate, and adjust hardware. Adjust doors to operate easily without binding.

3.5 PROTECTION

A. Protect lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.

B. Touch up marred finishes, or replace lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 105126

SECTION 111319 - STATIONARY LOADING DOCK EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes motorized, recessed dock levelers.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for loading dock platform edge channels and for steel access ladders.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Inspect and discuss electrical roughing-in, equipment bases and other preparatory work specified elsewhere.
2. Review sequence of operation for each type of loading dock equipment.
3. Review coordination of interlocked equipment specified in this Section and elsewhere.
4. Review required testing, inspecting, and certifying procedures.

1.4 DEFINITIONS

A. Operating Range: Maximum amount of travel above and below the loading dock level.

B. Working Range: Recommended amount of travel above and below the loading dock level for which loading and unloading operations can take place.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for stationary loading dock equipment.
2. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Shop Drawings: For stationary loading dock equipment.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of anchors and field connection.
3. Include diagrams for power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Welding certificates.

C. Product Test Reports: For each dock leveler, for tests performed by manufacturer and witnessed by a qualified testing agency.

1. Indicate compliance of dock levelers with requirements in MH 30.1 for determining rated capacity, which is based on comprehensive testing within last two years of current products.
2. Submittal Form: According to MH 30.1.

D. Sample Warranty: For manufacturer's special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For stationary loading dock equipment to include in operation and maintenance manuals.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of stationary loading dock equipment that has been used for similar applications with successful results, that meets or exceeds performance requirements indicated, and of documenting this performance by inclusion in test reports. Manufacturer shall have factory-authorized service representatives who are available for consultation, periodic Project-site observations, and on-site assistance.

B. Installer Qualifications: A firm with not less than 5 years' experience installing stationary loading dock equipment similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code - Steel."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.9 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of construction contiguous with stationary loading dock equipment, including slopes of driveways and heights of loading docks, by field measurements before fabrication. Show on Shop Drawings.

1.10 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace dock levelers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including cracked or broken structural support members, load-bearing welds, and front and rear hinges.
b. Faulty operation of operators, control system, or hardware.
c. Deck plate failures including cracked plate or permanent deformation in excess of 1/4 inch between deck supports.

2. Warranty Period for Structural Assembly: 10 years from date of Substantial Completion.
3. Warranty Period for Hydraulic Assembly: 5 years from date of Substantial Completion.
4. Warranty shall be for unlimited usage of leveler for the specified rated capacity over the term of the warranty.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 RECESSED DOCK LEVELERS

A. General: Recessed, hinged-lip-type dock levelers designed for permanent installation in concrete pits preformed in the edge of loading platform; of type, function, operation, capacity, size, and construction indicated; and complete with controls, safety devices, and accessories required.

1. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide recessed dock levelers by the following:

a. Rite-Hite Holding Corporation; RHH Series.

B. Standard: Comply with MH 30.1, except for structural testing to establish rated capacity.

C. Rated Capacity: Capable of supporting total gross load of 60,000 lbs without permanent deflection or distortion.

D. Platform: Not less than 1/4-inch-thick, nonskid steel plate.

1. Platform Size: As indicated on Drawings.
2. Frame: Clean-pit type, designed to support leveler at sides of pit, with no supports at front of pit floor.
3. Toe Guards: Equip open sides of dock leveler over range indicated with metal toe guards.

a. Toe-Guard Range: Entire upper operating range.

E. Hinged Lip: Not less than 3/4-inch-thick, nonskid steel plate.

1. Hinge: Full-width, piano-type hinge with heavy-wall hinge tube, with gussets on lip and ramp for support.
2. Safety Barrier Lip: Designed to protect material-handling equipment from an accidental fall from loading platform edge of the dock leveler when the leveler is not in use.

F. Function: Dock levelers shall compensate for differences in height between truck bed and loading platform.

1. Vertical Travel: Operating range above platform level of sufficient height to enable lip to extend and clear truck bed before contact with the following minimum working range:

a. Above Adjoining Platform: 12 inches.
b. Below Adjoining Platform: 12 inches.

2. Automatic Vertical Compensation: Floating travel of ramp with lip extended and resting on truck bed shall compensate automatically for upward or downward movement of truck bed during loading and unloading.
3. Automatic Lateral Compensation: Tilting of ramp with lip extended and resting on truck bed shall compensate automatically for canted truck beds of up to 4 inches over width of ramp.
4. Lip Operation: Manufacturer's standard mechanism, which automatically extends and supports hinged lip on ramp edge with lip resting on truck bed over dock leveler's working range, allows lip to yield under impact of incoming truck and automatically retracts lip when truck departs.

a. Length of Lip Extension: 18 inches.

5. Automatic Ramp Return: Automatic return of unloaded ramp, from raised or lowered positions to stored position, level with platform, as truck departs.

G. Hydraulic Operating System: Electric control from a remote-control station; fully hydraulic operation. Electric-powered hydraulic raising and hydraulic lowering of ramp. Equip leveler with a packaged unit including a unitized, totally enclosed, nonventilated electric motor, pump, manifold reservoir, and valve assembly of proper size, type, and operation for capacity of leveler indicated. Include means for lowering ramp below platform level with lip retracted behind dock bumpers. Provide a hydraulic velocity fuse connected to main hydraulic cylinder to limit loaded ramp's free fall to not more than 3 inches

1. Remote-Control Station: Weatherproof single-button station of the constant-pressure type, enclosed in NEMA ICS 6, box. Ramp raises by depressing and holding button; ramp lowers at a controlled rate by releasing button.

H. Construction: Fabricate dock-leveler frame, platform supports, and lip supports from structural- or formed-steel shapes. Weld platform and hinged lip to supports. Fabricate entire assembly to withstand deformation during both operating and stored phases of service. Chamfer lip edge to minimize obstructing wheels of material-handling vehicles.

1. Cross-Traffic Support: Manufacturer's standard method of supporting ramp at platform level in stored position with lip retracted. Provide a means to release supports to allow ramp to descend below platform level.
2. Maintenance Strut: Integral strut to positively support ramp in up position during maintenance of dock leveler.

I. Integral Laminated-Tread Dock Bumpers: Fabricated with two 12-inch-high by 4-inch-deep uniformly thick plies cut from fabric-reinforced rubber tires. Laminate plies under pressure on not less than two 3/4-inch-diameter, steel supporting rods that are welded at one end to 1/4-inch- thick, structural-steel end angle and secured with a nut and angle at the other end. Fabricate angles with predrilled anchor holes and sized to provide not less than 1 inch (25 mm) of tread plies extending beyond the face of closure angles.

J. Materials:

1. Steel Plates, Shapes, and Bars: ASTM 36.
2. Rolled-Steel Floor Plate: ASTM A 786, rolled from steel plate complying with ASTM A 572, Grade 55 (380).
3. Steel Tubing: ASTM A 500, cold formed.
4. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

K. Dock-Leveler Finish: Manufacturer's standard finish.

1. Toe Guards: Paint toe guards to comply with ANSI Z535.1.

L. Accessories:

1. Curb Angles: 3-by-3-by-1/4-inch galvanized-steel curb angles for edge of recessed leveler pit, with 1/2-inch- diameter by 6-inch- long concrete anchors welded to angle at 6 inches o.c.
2. Self-Forming Pan: Manufacturer's standard prefabricated, self-forming steel form system for poured-in-place construction of concrete pit.
3. Night Locks: Manufacturer's standard means to prevent extending lip and lowering ramp when overhead doors are locked.
4. Side and rear weatherseals.

2.3 FINISH REQUIREMENTS

A. Finish loading dock equipment after assembly and testing.

B. Galvanizing: Hot-dip galvanize components to comply with the following:

1. ASTM A 123 for iron and steel loading dock equipment.
2. ASTM A 153 or ASTM F 2329 for iron and steel hardware for loading dock equipment.

C. Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat in manufacturer's standard color.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical systems for loading dock equipment to verify actual locations of connections before equipment installation.

C. Examine walls and floors of pits for suitable conditions where recessed loading dock equipment is to be installed. Pits shall be plumb and square and properly sloped for drainage from back to front of loading dock.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordinate size and location of loading dock equipment indicated to be attached to or recessed into concrete or masonry, and furnish anchoring devices with templates, diagrams, and instructions for their installation.

B. Set curb angles in concrete edges of dock-leveler recessed pits with tops flush with loading platform. Fit exposed connections together to form hairline joints.

C. Place self-forming pan system for edge-of-dock levelers in proper relation to loading platform before pouring concrete.

D. Clean recessed pits of debris.

3.3 INSTALLATION

A. General: Install loading dock equipment as required for a complete installation.

1. Rough-in electrical connections.

B. Recessed Dock Levelers: Attach dock levelers securely to loading dock platform, flush with adjacent loading dock surfaces and square to recessed pit.

3.4 ADJUSTING

A. Adjust loading dock equipment to function smoothly and safely, and lubricate as recommended by manufacturer.

B. Test dock levelers for vertical travel within operating range indicated.

C. After completing installation of exposed, factory-finished loading dock equipment, inspect exposed finishes and repair damaged finishes.

3.5 MAINTENANCE SERVICE

A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of loading dock equipment Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper loading dock equipment operation at rated speed and capacity. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain loading dock equipment.

END OF SECTION 111319

SECTION 113100 - APPLIANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Refrigeration appliances.
2. Microwave appliances.
3. Built-in dishwashers.

B. Related Requirements:

1. Section 064023 "Interior Architectural Woodwork" for coordinate with cabinets adjacent to appliances.
2. Divisions 22 plumbing section(s) for plumbing and plumbing connections.
3. Division 26 electrical section(s) for electrical and electrical connections.

1.3 COORDINATOIN

A. Installation Templates: Distribute installation templates of appliances to millworker and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are being made to receive appliances.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include installation details, material descriptions, dimensions of individual components, and finishes for each appliance.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Product Certificates: For each type of appliance.

C. Field quality-control reports.

D. Sample Warranties: For manufacturers' special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each appliance to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 20 years' experience regularly engaged in the production and sales of appliances, including accessible ADA-compliant units, that have been used for similar applications with successful results, that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports. Manufacturer shall maintain, within 50 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

B. Installer Qualifications: A firm with not less than 10 years' experience installing appliances similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

1.8 WARRANTY

A. Special Warranties: Manufacturer agrees to repair or replace appliances or components that fail in materials or workmanship within specified warranty period.

B. Refrigerator/Freezer, Sealed System: Full warranty, including parts and labor, for on-site service on the product.

1. Warranty Period for Sealed Refrigeration System: Five years from date of Substantial Completion.
2. Warranty Period for Other Components: Two years from date of Substantial Completion.

C. Microwave Oven: Limited warranty, including parts and labor for first year and parts thereafter for magnetron tube.

1. Warranty Period for Magnetron Tube: Ten years from date of Substantial Completion.

D. Dishwasher: Full warranty, including parts and labor, for on-site service on the product.

1. Warranty Period for Deterioration of Tub and Metal Door Liner: Ten years from date of Substantial Completion.
2. Warranty Period for Other Components: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain appliances from single source.

2.2 PERFORMANCE REQUIREMENTS

A. Electrical Appliances: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Accessibility: Where appliances are indicated to comply with accessibility requirements, comply with applicable provisions in the DOJ's 2010 ADA Standards for Accessible Design and the accessibility requirements of the 2016 California Building Code.

2.3 REFRIGERATOR/FREEZERS

A. Refrigerator/Freezer: Two-door refrigerator/freezer with freezer on bottom and complying with AHAM HRF-1.

1. Manufacturers: Subject to compliance with requirements, provide refrigerator/freezer by one of the following:

   a. General Electric.
   b. LG.
   c. Whirlpool.

2. Type: Freestanding.
3. Dimensions:

   a. Width: As indicated on Drawings.
   b. Depth: As indicated on Drawings.
   c. Height: As indicated on Drawings.

4. Storage Capacity: Based on dimensions as indicated on Drawings, but no less than nominal 23 cubic feet capacity.
5. General Features:

   a. Built-in water-filtration system.
   b. Dual refrigeration systems.
   c. Separate temperature controls for each compartment.
   d. Automatic defrost.

6. Refrigerator Features:

   a. Interior light in refrigeration compartment.
   b. Temperature-controlled meat/deli bin.

7. Freezer Features: One freezer compartment with door configured as pull-out drawer.

   a. Automatic defrost.
   b. Interior light in freezer compartment.
   c. Automatic icemaker and storage bin.

8. ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product-labeling program.
9. Front Panel(s): Stainless steel.
10. Appliance Color/Finish: Stainless steel.

B. Undercounter Refrigerator: One-door under-counter refrigerator complying with AHAM HRF-1.

1. Manufacturers: Subject to compliance with requirements, provide refrigerator by one of the following:

   a. General Electric.
   b. LG.
   c. Whirlpool.

2. Type: Undercounter.
3. Dimensions:

   a. Width: As indicated on Drawings.
   b. Depth: As indicated on Drawings.
   c. Height: As indicated on Drawings.

4. Storage Capacity: Based on dimensions as indicated on Drawings.

5. Refrigerator Features:

   a. Interior light in refrigeration compartment.
   b. Automatic defrost.

6. ENERGY STAR: Provide appliances that qualify for EPA/DOE ENERGY STAR product-labeling program.
7. Front Panel(s): Stainless steel.
8. Appliance Color/Finish: Stainless steel.

2.4 MICROWAVE OVENS

A. Microwave Oven:

1. Subject to compliance with requirements, provide microwave ovens by one of the following:

    a. General Electric.
    b. LG.
    c. Whirlpool.

2. Mounting: As indicated on Drawings.
3. Type: Conventional.
4. Dimensions: As indicated on Drawings, or if not indicated, of size to maximize capacity of microwave over within space allotted.
5. Oven Door: Door with observation window and pushbutton latch release.
6. Microwave Power Rating: Manufacturer's standard, but no less than 1000 W.
7. Electric Power Supply: 120 V, 60 Hz, 1 phase, 15 A.
8. Controls: Digital panel controls and timer display.
9. Other Features: Turntable.
10. Material: Stainless steel.

2.5 DISHWASHERS

A. Dishwasher: Complying with AHAM DW-1.

1. Subject to compliance with requirements, provide microwave ovens by one of the following:

    a. General Electric.
    b. LG.
    c. Whirlpool.

2. Type: Built-in undercounter.
3. Dimensions: As indicated on Drawings, or if not indicated, of size to maximize capacity of dishwasher within space allotted.
4. Tub and Door Liner: Stainless steel with sealed detergent and automatic rinsing-aid dispensers.
5. Rack System: Nylon or PVC-coated sliding dish racks, with removable cutlery basket.
6. Controls: Touch-pad controls with four wash cycles and hot-air and heat-off drying cycle options.
7. Features:

    a. Waste food disposer.
    b. Self-cleaning food-filter system.
    c. Hot-water booster heater for 160 deg F wash water with incoming water at 100 deg F.
    d. Lock-out feature.
    e. Half-load option.
    f. Delay-wash option.
    g. Digital display panel.
    h. Soil-sensing water use control system.

8. ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product-labeling program.
9. Front Panel: Stainless steel.
10. Appliance Color/Finish: Stainless steel.

2.6 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of appliances.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before appliance installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install appliances according to manufacturer's written instructions.

B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.

C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

3.3 FIELD QUALITY CONTROL (BY CONTRACTOR)

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Perform visual, plumbing, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance-performance parameters.
2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After installation, start units to confirm proper operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.

B. An appliance will be considered defective if it does not pass tests and inspections.

C. Repair and replace units that do not comply with testing and inspections.

D. Prepare test and inspection reports.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain appliances.

END OF SECTION 113100

SECTION 114000 – FOODSERVICE EQUIPMENT

PART 1 - GENERAL

1.1 DEFINITIONS, STANDARDS AND CONDITIONS

OF/OI	Owner Furnished/Owner Installed
KECF/KECI	Kitchen Equipment Contractor Furnished/ Kitchen Equipment Contractor Installed
KEC/CGI	Contractor Furnished/General Contractor Installed
GCF/GCI	General Contractor Furnished/General Contractor Installed
VF/VI	Vendor Furnished/Vendor Installed
KEC	Kitchen Equipment Contractor
G.C.	General Contractor

1.2 GENERAL INSTRUCTIONS TO BIDDERS

A. Food service equipment to be supplied and installed by the KEC. General Contractor to make all final utility connections and interconnections required.

B. Food Service Equipment shall be provided in accordance with the requirements set forth in this section and the architectural general requirements.

C. List all sub-contractors in the proposal. They must be mutually acceptable and approved by Owner and MÜLLER DESIGN INC.

D. The Owner is not obligated to accept the lowest or any other bid.

E. Food service contractor is to review in its entirety the documents attached prior to asking MÜLLER DESIGN ASSOCIATES questions concerning said documents. It is requested that any questions concerning bidding be sent via email.

F. Submit pricing for all items of commercially manufactured equipment per specification or as indicated on drawings.

1.3 SUBSTITUTIONS

A. Contractor may NOT submit substitutes unless listed in these documents. Substitutes will only be considered after contract is awarded in a period of budget realignment with the awarded contractor.

B. The drawings listed on page 1 of this document, as well as all Custom Detail sheets and cut sheets, are to be included as part of the Bid Set of Documents.

1.4 SCOPE OF WORK

A. The work as outlined herein consists of providing all materials, labor, plant facilities, fabrication of custom equipment, purchase of commercially manufactured equipment (buy-outs) supervision, delivery and installation of all numbered items (whether purchased or not by the contractor,) unless noted otherwise in strict accordance with these specifications, applicable drawings and local codes including that which is reasonably inferred.

B. The scope of work requires meeting all deadlines for installation as set by the architect and contractor that these deadlines and limits are part of this work and are his responsibility for compliance.

1.5 WORK INCLUDED

A. Furnish, deliver and install all items listed or otherwise indicated in specifications or on drawings.

B. At all times, during the delivery, assembly and installation of the items listed, the Contractor is to coordinate his work with the General Contractor.

C. Cutting of holes in items for pipes, drains, electrical conduit and outlets, etc., as required for installation. Include welded sleeves, collars, ferrules or escutcheons as required to property finish and trim these openings.

D. Pre-wiring of fabricated items to a junction box, pull box or breaker panel, wholly accessible, mounted on the item. Label wiring for outlet or item served, or wired to breaker for single point connection.

E. All exposed ductwork, including trim, from hoods, ventilators and baffles to finished walls and ceilings within rooms including final connection to duct work beyond.

F. Pre-plumb fabricated items. The equipment shall be completely piped and interconnected. Connection terminals to be accessible. All steam piping and components to be completely installed. All connections to be accessible. Faucets to be furnished loose for installation by the General Contractor.

G. Repair any damage done to the building, premises and items, by this Contractor or sub-contractors as employed by him during this installation.

H. Daily removal all debris left by those engaged in this installation.

I. All items included in this contract shall be cleaned, tested and ready for operation at the time the building is turned over to the Owner.

J. Contractor to arrange for factory demonstrations of all major mechanical equipment. The demonstrations shall be scheduled with the owner or the owner's designated representative and MÜLLER DESIGN INC. The contractor shall have his superintendent present for the demonstrations. The owner’s chef or representative shall sign off on all demonstrations.

K. Contractor shall provide an Owner’s Manual in three copies. This Owner’s Manual shall detail all items furnished, all operations manuals, all warranties and all service agencies responsible for those warranties.

1.6 WORK NOT INCLUDED

A. All electrical services including conduit, wiring and final connections to the food service equipment.

B. All water, steam, gas and waste services to the items, including all shut-off valves, traps, and final connections to the items except as specified in individual items or shown on drawings to the contrary.

C. All hood or ventilator duct work beyond the wall or ceiling connection position.

1.7 DESIGN DRAWINGS AND SPECIFICATIONS

A. Drawings which constitute a part of these contract documents, either as separate sheets or bound herein, indicate arrangements, locations, approximate or nominal dimensions, adjacent conditions and detailed design of custom fabricated items

.

B. The drawings and specifications are for the assistance and guidance of the Contractor. Accuracy of these drawings is not guaranteed and existing building conditions will influence exact dimensions, locations and levels, deviations from this arrangement in order to meet structural conditions shall be made without expense to the Owner. Further, the plans, drawings and specifications herein are based on architectural plans which may have been changed, modified or revised for budgetary reasons since issuance to or by MÜLLER DESIGN INC. The Contractor may be required to revise and resubmit drawings and plans to meet these conditions and to receive approvals. The Contractor accepts this contract with this

understanding. These approval, fees, permits and costs of preparation of documents shall be entirely borne by the Contractor and no supplemental costs shall be paid over the contract value to the Contractor for this work.

1.8 ERRORS, OMISSIONS & AMBIGUITIES

A. Report any errors, omissions or ambiguities found in drawings and specifications to MÜLLER DESIGN ASSOCIATES for clarification and resolution, before bids are submitted. MÜLLER DESIGN ASSOCIATES will issue a clarification memo or cause an addendum to be issued, if required.

B. No allowances will be made in favor of the Contractor for errors, omissions or ambiguities reported after award of contract.

C. In the event of a conflict between documents, the following will govern:
   1. Precedence of the contract documents: the most recently issued document takes precedence over previous issues of the same documents.

D. Conflicts within the contract documents: interpretation shall be made observing the following hierarchies and in the order stated:
   1. Code requirements take precedence over requirements stated elsewhere in the contract documents.
   2. More stringent requirements take precedence over less stringent requirements.
   3. Greater quantity and greater quality take precedence over lesser quantity and lesser quality.

E. Omissions: Work not particularly detailed, marked or specified shall be the same quality as similar work that is detailed, marked or specified.

1.9 CHANGES IN WORK

A. Any changes before award of contract shall be made by written addendum to the specifications.

B. Contractor shall acknowledge receipt of addendum in writing and shall notify both Owner and MÜLLER DESIGN ASSOCIATES of any resulting price adjustments to the bid or contract price total.

C. Any changes after award of contract shall be made by written change orders if and only if they are resulting from changes made by the owner or MÜLLER DESIGN ASSOCIATES to the scope of work or to the list of equipment or options.

D. Contractor shall acknowledge receipt of change order in writing and shall notify both Owner and MÜLLER DESIGN ASSOCIATES of any resulting price adjustments to the bid or contract price total.

1.10 CODES & REGULATIONS

A. All work shall conform to local, state and Federal codes and regulations and requirements and the following:

B. Work and materials shall be in full accord with the latest rules and /or regulations of agencies or authorities having jurisdiction. Those regulations include building codes, steam codes, gas codes, electrical codes, health codes and any other codes. Rulings and interpretations of the enforcing agencies shall be considered a part of the regulations. It is the Contractor’s responsibility to satisfy all of these requirements and to produce all necessary certificates of compliance.

C. Conform all electrically operated and/or heated equipment, fabricated or otherwise to the latest Standards of National Electric Manufacturers Associates, Underwriter's Laboratories, Inc., National Electric Code, or local standards acceptable to authorities having jurisdiction. It is expressly understood by the contractor that all equipment installed under this contract, whether purchased by the contractor or not, must bear proper and current labels for NSF and UL or ETL compliance. The contractor accepts responsibility for

insuring all items installed are in compliance. Any and all exceptions must be brought to the attention of the owner and MÜLLER DESIGN ASSOCIATES for resolution prior to purchase and installation.

D. Standard steam heated equipment shall be manufactured in per A.S.M.E. code requirements and carry the A.S.M.E. stamp.

E. Conform all gas-fired equipment to American Gas Association (A.G.A) requirements. Equip burners for gas-heated equipment with automatic lighters. Equip oven burners and other concealed burners with automatic safety pilots, to conform to A.G.A. Standards

.

F. All finishes applied to equipment must meet the requirements set forth in the A.S.T.M. E84 tunnel test and toxicity determination if required by local code. If local codes require a higher standard they shall govern.

G. Wood materials must be fire retardant and comply with the flame-spread rating required by code. It is this Contractor's responsibility to satisfy all requirements and to produce all necessary certificates of compliance.

H. Conform all applicable items to the latest Standard and Revisions established by the National Sanitation Foundation, Ann Arbor, Michigan.

I. All ducts, fire protection systems and grease exhaust hoods or ventilators must meet National Fire Protection Association, Inc. (N.F.P.A.) requirements.

1.11 COMMERCIALLY MANUFACTURED EQUIPMENT

A. Products shall conform to local, state and Federal requirements and the following:

B. All items of standard equipment shall be the latest model at the time of delivery. If these model specifications vary significantly from the item of equipment specified, these variations must be brought to the attention of MÜLLER DESIGN ASSOCIATES before installation for review and approval.

C. Manufacturer's directions shall be followed in cases where the manufacturers of articles used in this contract furnish directions or prints covering points not shown on the drawings or specifications

.

D. All manufactured equipment shall be furnished with all proper union, NSF, and UL or ETL labels in compliance with all local, state and Federal codes. It is the contractor’s responsibility to insure compliance and proper labeling.

1.12 QUALITY ASSURANCE

A. Perform all work to the highest quality by skilled, experienced craftsmen of the respective trades involved.

B. Fabricate all custom sheet metal items by one manufacturer acceptable to the Owner and Designer.

C. Fabricate all custom wood items by one manufacturer acceptable to the Owner and Designer.

D. Quietness of operation is a requirement. Remove and repair any item producing objectionable noise.

E. Purchasing - The Contractor to order all commercially manufactured equipment (buy-outs) and materials as soon as possible after letting of the contract. The Contractor is also responsible for the prompt ordering by his sub-contractors. Substitution of items will not be allowed or approved for the sake of expediency, when prompt ordering would have allowed adequate time for delivery, fabrication and installation. In instances where such tardiness in purchasing contributes to delay that might affect a scheduled completion date, it will be the responsibility of the Contractor to assume all related costs involved in taking all feasible measures to speed the production, delivery and installation of such items.

F. Coordination - The Contractor is responsible to coordinate all phases of his work with the various other

contractors involved in a professional and amicable manner, to ensure a complete understanding of responsibilities, scheduling of installation phases, and to avoid delays, interruptions and disagreements.

G. Cooperation - The Contractor is to actively cooperate with those engaged in work requiring the cutting, fitting or setting of specified items to facilitate completion of the work.

H. Warranties- The Contractor accepts and warrants the full function and craftsmanship of all items installed under this contract, whether purchased or not by the Contractor for the period of one year from the turn-over of the kitchen to the owner. The Contractor further accepts the responsibility to repair and maintain in full and original working condition all equipment installed under this contract. Items deemed to be damaged by the installation process, or any items failing to meet full manufacturer's standards of operation, shall be replaced at the sole cost of the Contractor for the period of one year from the turnover of the kitchen to the owner.

I. The singular exception to the responsibility of warranting the equipment is in the case of owner's furnished items that are used or that have been in service prior to installation.

1.13 JOB CONDITIONS

A. Contractor shall field verify all plumbing, electrical and ventilation rough-in locations and sleeve and floor trough locations before and after the floor slabs are poured

.

B. In the event rough in has been completed before award of this contract, the Contractor shall check existing facility and furnish equipment to suit building conditions and utilities. It is the contractor's responsibility to review fabrications shop drawings for existing conditions requirements. Any extra charges required for utility changes to fit equipment during installation and connection will be brought to the owner's and MÜLLER DESIGN ASSOCIATES attention before authorization of additional work

.

C. Before ordering equipment, confirm with the serving electric utility all pertinent electrical requirements such as actual voltages available, number of phases and number of wires in system.

D. Report any major adjustments or conflicts arising out of unexpected field conditions not shown on the drawings to MÜLLER DESIGN ASSOCIATES for resolution prior to fabrication or purchase of any manufactured equipment effected.

E. Remove and correct, at the Contractor's expense, items installed and fitted without consideration of exact job dimensions or conditions to the satisfaction of Owner and MÜLLER DESIGN INC.

1.14 SUBMITTALS

A. Equipment brochures- Prior to proceeding with the purchase of manufactured equipment the contractor shall submit for review two (2) bound equipment brochures consisting of all equipment shown on the installation drawing, whether furnished by owner, contractor or vendor organized as follows:

1. Hard Cover.
2. Title Sheet.
3. Index Sheet listing all items.
4. Lead Sheet for each item of manufactured equipment showing: Item number, quantity, description, manufacturer's name, address and telephone number, model number, options & modifications, utilities required and special notes. Contractor may use his own form. Lead sheet to also include incorporation of LEED compliance requirements as indicted below.
5. Manufacturer's Catalog sheet or shop drawing. Manufacturer's warranties must be fully detailed.

B. Upon receipt of review critique and approval of equipment brochures, the Contractor shall make any

revisions required by the review and prepare six (6) bound sets for distribution as directed.

C. Shop drawings: Prior to proceeding with the fabrication of custom equipment shop drawings must be submitted for review as follows:

1. Shop drawings are to show clearly the construction, required reinforcements, finishes, hardware, precise dimensions, installation instructions and methods of fastening.

2. Include drawings submitted by sub-contractors such as conveyors, cold storage rooms, hoods, ventilators, etc.

3. Shop drawings are to be submitted in the form of right reading reproducible transparencies (vellum, ozalid paper, sepia or equal)

4. Size of drawings shall be consistent for all items. Sheet sizes to match contract document drawing size.

5. Minimum scale of drawings shall be 1"=1'-0" (1:10) for elevations and 1-1/2"=1'-0". (1:5) for sections. Full size details are required to show critical assembly joints, edge and corner details or cut-outs.

6. Each drawing shall clearly indicate project name, description, item number and quantity, as per MÜLLER DESIGN ASSOCIATES specifications.

7. All shop drawings shall be rolled, not folded, and submitted in mailing tubes. Folded sepias will be returned without review for resubmittal.

D. Manufacturer's Operating Instructions: Prior to the completion of the installation, submit for review three (3) bound copies of complete operating instructions, parts replacement lists and, names, addresses and telephone numbers of local servicing companies of all mechanical and electrical equipment for manufacturers not having local servicing agencies, list persons or departments to contact at their factory. Contractor will schedule manufacturer’s representatives to demonstrate, calibrate and hand over all purchased equipment requiring special skills for operation. Contractor will prepare and distribute, a minimum of two (2) weeks in advance, the schedule of demonstrations for approval by owner and operator.

E. LEED compliance requirements for all equipment items:
Each item to include indication of separate percentages, by weight, of pre-consumer and post-consumer recycled material per unit of production. Include material costs, excluding cost of installation for recycled material.

F. Each item lead sheet to include information on the location the manufacturer’s facility where equipment item was produced and/or assembled and its distance to the project site. Equipment manufacturers to provide information on the raw material manufacturing/extraction facilities location and its distance to the manufacturers production and/or assembly facility and project site. Raw material items to include but not be limited to stainless steel, all metals, wood product, glass etc.

G. Submittal Review - Submitted documents will be reviewed and returned to the Contractor. The Contractor is responsible for the accuracy of information on all of his submittals. Review of rough-in drawings, equipment brochures and shop drawing is for design and concept only, and does not relieve the Contractor of the responsibility for compliance with design drawings, details and specifications, nor does it relieve him of the responsibility of verification of utilities with equipment requirements, conformance with regulations and coordination with building conditions.

1.15 DELIVERY, STORAGE AND HANDLING

A. No provisions are normally made for receipt or storage of any item delivered to the job site before commencement of installation.

B. Commercially manufactured equipment (buy-outs), shall be purchased, received and accounted for by the contractor, at its warehouse facilities until such time as placement is possible and acceptable by Owner. The Contractor shall provide at least 24 hours notice to the general contractor prior to delivery of equipment to the site.

C. Fabricated equipment and commercially manufactured equipment (buy-outs) must be stored by this Contractor at his warehouse facilities until such time as placement is possible and acceptable by the Owner or building management.

D. Clearly identify all items by MÜLLER DESIGN ASSOCIATES item number and area prior to delivery to the job-site.

E. Under no circumstances shall any individual or agent of the owner, architectural, trades, maintenance or security companies be asked to sign for or receive goods, equipment or services on the job site. Items, parts, optional pieces, trim, or any goods provided under this contract are the responsibility of the contractor whether on the owner's property or in transit until the areas shown in these documents are handed over to the owner or owner's agents.

1.16 INSTALLATION

A. Contractor shall supervise and direct his work using his best skill and attention. During the entire installation period, the Contractor shall provide a competent superintendent or foreman for such directions regarding connection, installation and coordination of all work under this contract. The Owner or MÜLLER DESIGN ASSOCIATES shall be sole judges as to the competence of said supervisor.

B. Contractor shall be solely responsible for all construction means, methods, techniques, procedures and coordination of all portions of his work under the contract and for coordinating the installations with the General Contractor, so as not to interfere with or delay the overall construction of the project.

C. Contractor shall verify conditions at the building, particularly door openings, passages, and availability and size of elevators and avoid building any items too large for available openings. Contractor shall provide for the possible necessity of removing and replacing windows or wall panels. Any pieces too bulky for existing facilities shall be hoisted or otherwise handled with apparatus as required. The Contractor shall pay all special handling equipment charges

.

D. Floor troughs and drip pans shall be provided by Contractor and installed by the General Contractor. The Contractor shall provide a supervisor for the installation.

E. Accurately set, scribe, square, level and permanently secure all items in precise position as indicated on drawings and shop drawings. Exercise extreme care to avoid damaging finished surfaces during the handling and erecting of all items. Repair, replace or otherwise make good all damaged surfaces or blemishes arising from installation in a manner approved by the Owner.

F. Complete installation with required fastenings, clip angles, braces, anchors and other fittings as required to render the work rigid and secure. Secure wood items with screws or anchor to furring strips to permit removal.

G. Caulk all items resting on concrete pads to eliminate crevices between item and pad.

H. Shim level items without legs with stainless steel shims. Caulk watertight to eliminate crevices between item and mounting surfaces on floor.

I. Seal spaces between all units and walls, ceilings, floors or fixed adjoining units against entrance of food particles or vermin by means of trim strips, welding, soldering, or commercial joint material as suited to the nature of the equipment. Seal and smooth, (when not exposed to extreme heat) with General Electric Silicone Construction Sealant Series SE1200 in appropriate color. Width of joints sealed with silicone not to exceed 1/4".

J. Contractor shall do all cutting and fitting on the equipment required by other contractors for access for

their piping, conduit or utility access.

K. Do not use any exposed bolts nuts or screws other than those shown on shop drawings. Any additional and approved bolts, nuts or screws must be stainless steel.

L. Protect equipment that has been delivered to the jobsite from damage. Counter and table tops to be covered with plywood, flakeboard or hardboard during the installation period. Completion of installation, clean and polish all surfaces of each item with appropriate materials. At this time, prepare to account to the consultant and Owner for quantities, locations and conditions of all items.

M. Should any repairs be required due to the neglect of the other contractors, the repairs must be approved by owner before the work is performed. All extra charges must be approved and all repairs required must be noted in writing before work is performed, stipulating the price and by whom the extra expense is to be paid. In case the Contractor does not secure such extra order, the expense shall be borne by him. No cutting, notching, drilling or altering of any kind shall be done to the building by the contractor without first obtaining permission from the owner, or architect.

N. Throughout the progress of the work, the Contractor shall keep the working area free from debris of all types, and remove from premises all rubbish resulting from any work being done by him. At the completion of work, the Contractor shall leave the premises in a clean and finished condition.

O. LEED compliance requirement: Contractor to manage all construction waste material resulting from installation of foodservice equipment items in accordance with provisions of the Waste Management spec section. Documentation shall be submitted to satisfy the requirements of that section.

1.17 GUARANTEE

A. All items furnished by the Contractor shall be guaranteed against defects in workmanship and material. All repairs and replacements which may become apparent and necessary by reason of such defect, during the first year after final completion and acceptance of the equipment installation, shall be made by the Contractor at his own cost and expense and without charge to the Owner. Guarantee period shall commence with usage of equipment for its intended purpose by the operator of the business. All such repairs and replacements shall be made at a time and during hours satisfactory to the Owner and operator. All self-contained and remote refrigeration systems furnished under this contract shall include start up and one year service and maintenance contract in addition to the regular one year guarantee outlined above, plus an additional four year guarantee on all compressors. This includes refrigeration racks, refrigerators, ice cream cabinets, ice makers, freezers, etc.

PART 2 - MATERIALS

2.1 METAL

A. Stainless Steel shall be standard 18-8, 300 Series, No.4 finish unless otherwise noted. Gauge requirements are as follows:

U.S.S GAUGE	DECIMAL THICKNESS	MILLIMETER THICKNESS
10	.1406	3.57
12	.1094	2.78
14	.0781	1.98
16	.0625	1.59
18	.0500	1.27
20	.0375	0.95
22	.0312	0.79

B. Galvanized Steel shall be electro-galvanized, continuous line, chemically treated (dry) with regular spangle appearance. Gauge requirements as follows:

U.S.S. GAUGE	DECIMAL THICKNESS	MILLIMETER THICKNESS
10	.1382	3.51
12	.1084	2.75
14	.0785	1.99
16	.0635	1.61
18	.0516	1.31
20	.0396	1.01
22	.0336	0.85

C. Brass shall be copper alloy #260, cartridge or equal suitable for application and finish as detailed and indicated in finish schedule or drawings.

2.2 WOOD

A. All solid wood shall be thoroughly air-seasoned or kiln-dried to a moisture content of between 6% to 11% before fabrication. Evidence of proper seasoning shall be submitted to MÜLLER DESIGN ASSOCIATES upon request.

1. Wood used for framing and casework construction shall be smooth, free of mineral or sapwood streaks, checks, unsound knots or other defects.

2. Wood receiving enamel or other paint finishes shall be hardwood of uniformly dense texture and grain, such as birch, maple, beech or alder.

3. Finished woods or hardwood solid stock for finish work shall be clear selected lumber of the best grade of the species by the National Hardwood Association and shall carry the Association's Inspection Certificate. Lumber shall be free of mineral or sapwood streaks, checks, or other defects and such solid stock shall be selected for grain and uniform color suitable for use with a hardwood veneer plywood.

B. All plywood used for construction of specified items shall be new and of the best quality of its kind obtainable and shall carry the label of an accredited association or manufacturer.

1. Interior Plywood for closed interiors, shelves and partitions that are stained shall be Douglas Fir, Grade A. Face veneers, shall be well joined and reasonably matched, but shall not contain plugs,

knots, pitch pockets, splits, rough grain, checks or other open defects.

2. Plywood for painted work or for plastic laminate shall have hardwood veneer face of densely grained smooth and even texture, such as birch or beech and shall be free from patches, plugs, checks or other open defects.

3. Hardwood veneer plywood used on exposed exterior that are to receive either transparent natural or stained finishes, shall be of specified species, grain and texture.

4. Veneer core plywood with the required face woods shall be 3 ply for 1/4" (6mm) panels, 5 ply for 3/8" (9mm) and 1/2" (12mm) panels and 7 ply for 3/4" (19mm) panels with water resistant bond.

5. Face veneers are to be carefully matched for continuity and uniformity of grain, color and texture throughout the work specified.

6. Back veneers shall be of species and thickness to properly balance and complement face veneers.

7. Samples are to be provided to MÜLLER DESIGN ASSOCIATES for selection and approval prior to manufacture.

C. Fire-Retardant Plywood. Where the local code requires fire-retardant construction, all above general specifications shall apply, except that all panels used for the work shall carry class group labels by Underwriters Laboratories, Inc. of the required rating.

2.3 PLASTIC LAMINATE

A. Plastic Laminate to be manufactured under the current standards of NEMA LP2-1957. General purpose Type 1, 1/16" (2mm) thick, Class I wear resistance, color and finish as indicated in finish schedule.

2.4 APPLIED FINISHES

A. Pigmented paints, enamels or lacquers shall be factory mixed to colors selected or specified by MÜLLER DESIGN INC.

B. Stains shall be of the best fade-proof and penetrating quality of accredited brands, and shall be mixed and blended by the finisher to achieve desired tone, or to match sample supplied to MÜLLER DESIGN INC.

C. Oils for natural or toned finishes as specified, shall be manufactured by Watco-Dennis Corporation, 1640 20th Street, Santa Monica, California or approved equal

.

D. Clear and transparent finish coatings shall be highly water, scratch and stain-resistant Polyurethane based or catalyzed vinyl materials of highest quality and shall be guaranteed against flaking or peeling.

2.5 GLASS

A. Clear: All glass shall be of first quality, as manufactured by Libbey-Owens-Ford Pittsburgh Plate Glass, or equal. Plate glass shall be 1/4" (6mm) thick glazing quality tempered plate, unless otherwise specified. Crystal glass shall be double strength unless otherwise shown on drawing. All exposed edges of glass shall be ground and polished.

B. Mirrors: All mirrors shall be 1/4" (6mm) polished plate with copper plated backs, free of all imperfections, ground and polished. All coated edges set into wood with black shellac applied to conceal reflection.

2.6 GLUE

A. First quality Urea formaldehyde resin with moisture resistance CS-35, Type II shall be used for construction.

B. Resorcinol-Formaldehyde resins shall be used where work may be exposed to wetness, dampness or heat with moisture resistance CS-35 Type I.

C. Contact cements shall be used for bonding high-pressure laminates.

2.7 LEED COMPLIANCE REQUIREMENTS (APPLICABLE TO BOTH CUSTOM FABRICATED AND MANUFACTURED EQUIPMENT ITEMS)

A. All materials used in the manufacturing or assembly of foodservice equipment items to utilize and/or contain the maximum amount of recycled content allowed to retain the materials integrity.

B. Preference shall be given to manufacturers whose facilities are within a 500 mile radius to the project site. Manufactures and custom fabricators to give preference to raw material providers that are within a 500mile radius to their manufacturing and/or assembly facility

PART 3 - MANUFACTURED PRODUCTS

3.1 LEG SOCKETS

A. Component Hardware Group Inc. Model A20-0206 stainless steel socket with flared top to fit 1-5/8" (40 mm) tubing with S/S Allen set screw. Outer shell to be 16 gauge stainless steel reinforced with 12 gauge mild steel insert welded to exterior shell.

3.2 COUNTER LEGS

A. Component Hardware Model A77-5048 stainless steel counter leg. Height shall be 6" (150mm) minimum and 7" (175mm) maximum. Furnish a 3-1/2" (85mm) square stainless steel plate with four countersunk holes. Plate to be fully welded to top for fastening leg.

3.3 FEET (STAINLESS STEEL)

A. Component Hardware Model AYE adjustable foot inserts with stainless steel round (bullet) foot and locking ring or equivalent unless otherwise specified.

3.4 CASTERS

A. Caster shall be heavy duty type, ball-bearing, solid or disc wheel with non-marking greaseproof polyurethane tire Component Hardware Series C31, 5” locking casters, or better.

B. Wheels shall be minimum 5" (130mm) diameter, unless specified otherwise, with a tread width of 1-3/16" (30mm) and capacity of 250 lbs. (l 15kg) per caster.

C. Wheels shall have stainless steel rotating wheel guard, sealed wheel and swivel bearings and polished plated finish unless otherwise noted.

D. Casters to be N.S.F. approved.

3.5 CATCHES

A. Magnetic catches to be self-aligning; 20 pound pull manufactured by Component Hardware, Model M30-5920 or better for the following applications:

1. Wood doors.

B. Friction catches to be adjustable spring loaded tension, solid brass with satin nickel finish manufactured by Component Hardware Model M22-2430 or better for the following applications:

1. Double pan stainless steel doors.

2. Stainless steel pan door with wood insert.

C. Edge-mount catches to be magnetic, heavy duty manufactured by Kason Industries Series #171.

D. Provide all fabricated doors with cylinder locks (if padlock hasp is not specified) for the following applications:
1. Refrigerated doors (non-flush).

2. Cylinder locks to be keyed differently in each area and master keyed for entire project. Verify areas with Owner or Operator.

E. Catches shall be mounted so as to relate to pulls.

3.6 HINGES

A. Torsion hinge manufactured by Rehco Corp for the following applications:
1. Flush type, self-closing refrigerator doors.

2. Flush type, self-closing metal pan door with wood insert.

B. Lift-off, stainless steel securely welded to door and mullion, manufactured by Component Hardware, Model M75-1002 for the following application:

1. Double and single pan stainless steel doors.

C. Edge-mount, R45-1010 by CHG Inc., three each per door for the following applications:

1. Refrigerated doors (non-flush).

D. Pivot hinge manufactured by Component Hardware Model R75-6661 (R75-6662) or better for the following application:

1. Light duty wood door without metal pan.

E. Blum hinge for the following doors:

1. Wood doors for wall cabinets only.

3.7 CONNECTION TERMINALS

A. All equipment shall be complete with connection terminals as standardized by equipment manufacturers, except where specified contrary, for other contractors to make plumbing, electrical, ventilation and refrigeration connections.

3.8 WATER PANS (EMBOSSED STEAM COILS)

A. Steam coils for pans shall be Tranter, Inc. "Platecoil", single embossed, 70ERS circuitry, with 14 Gauge stainless steel flat back sheet and 16 Gauge stainless steel embossed sheet, resistance seam welded directly to the backing sheet to form an integral bottom heating circuit.

B. Embossing shall consist of formed parallel flow channels,.1 23/32' (43.65mm) center to center dimensions 0.291 sq. in. (2.0 sq. cm) cross sectional area per channel.

C. Unit to be manufactured as a flat stretch out sized to form a pan. The size and configuration as shown on plans and details.

D. Provide with type FPT half inlet and outlet. Verify inlet and outlet size locations with application.

3.9 COLD PANS/SNOWPANS/SNOWBANKS(EMBOSSED REFRIGERANT COILS)

A. Embossed refrigerant coils for cold pans shall be Tranter, Inc. "Platecoil", single embossed, 60ES circuitry, with 16 Gauge stainless steel flat back sheet and 18 Gauge stainless steel embossed sheet, seam resistance welded directly to the backing sheet to form an integral bottom cooling circuit.

B. Embossing shall consist of formed parallel flow, channels, 1 23/32" (43.66mm) center to center dimensions 0.291 sq. in. (2.0 sq. cm) cross sectional area per channel.

C. Unit to be manufactured as a flat stretch out sized to form a pan. The size and configuration as shown on plans and details.

D. Provide stainless steel tubing inlet and outlet with full brass flare nuts. Verify inlet and outlet size locations with application.

3.10 COILS (FABRICATED REFRIGERATORS)

A. Coils for standard and fabricated refrigerators shall have vinyl plastic coatings, aluminum housings and drip pans installed in such a manner as to be replaceable. Salad refrigerators to have stainless steel housings and drip pans.

3.11 THERMOMETERS

A. Refrigerated compartments, fabricated and standard, shall be furnished with a 2 1/2"(63mm) diameter dial type thermometer with chrome plated bezels. Mount dials in apron above hinges or in splash 3” above countertop. Thermometer shall be adjustable and calibrated after installation. For pass-thru installations, mount thermometer on cook’s side.

3.12 GASKETS

A. Refrigerated compartment doors with locking latches fitted with a full-perimeter removable magnetic vinyl-latex gasket, gray in color.

B. Refrigerated compartment doors with non-locking hardware fitted with a full-perimeter removable magnetic vinyl-latex gasket, gray in color.

3.13 LIGHT FIXTURES

A. Refrigerated Under-counters: Custom fabricated and standard refrigerators shall be provided with vapor-tight light receptacles, shatterproof lamps and automatic door switches.

B. Display Type: Light fixtures within back bars, sneeze guards, display cases or under shelves and cabinets shall be as manufactured by CSL (Creative Lighting Systems) CSL Sure Task #2 lights ST16W lights or as specified. Verify mounting. Fabricator will mount and pre-wire all under-cabinet and shelving lights back to wall along underside in a fully concealed manner, clipped every 12” with a 12” pig tail for connection by building trades.

3.14 DISPENSERS (SELF LEVELING TYPE)

A. Verify size, height and weight of dish and glassware and submit same to factory so springs may be properly calibrated.

3.15 HARDWARE, (EXPOSED)

A. Exposed hardware shall normally have identical or similar finishes and shall be installed with a minimum of exposed fasteners.

PART 4 - FABRICATED METAL ITEMS

4.1 METAL APPLICATIONS AND SELECTIONS

A. The following gauges, metals and finishes will apply unless otherwise noted in the specifications or drawings:

DESCRIPTION	GAUGE	METAL	FINISH	#
1. Counter Body:				
a. Framework		14	Galv.	-
b. Aprons, partitions, backs and ends, exposed		18	S/S	4
c. Aprons, partitions, backs and ends, unexposed		18	Galv.	
d. Shelves		18	S/S	4 (top)
e. Shelving edges				7
f. Refrigerator interior		20	S/S	2B
2. Table & Counter Tops:		14	S/S	4
a. heated counter tops		12	S/S	4
b. vertical edges tops & overshelves		14	S/S	7
3. Doors:				
a. Outside faces		18	S/S	7
b. Inside faces		18	S/S	2B
4. Drawer Pans:				
a. Cradle Frame		14	S/S	4
b. Outside Pan		14	S/S	4
c. Inside Pan		18	S/S	4
5. Ducts:				
a. Grease Exhaust Exposed		18	S/S	4
b. Grease Exhaust Unexposed		16	S/S	
c. Warewashing		18	S/S	4
6. Hat Sections & Channels:				
a. Unexposed		12 or 14	Galv.	-
b. Exposed		12	S/S	4
7. Ice Pans/Bins:				
a. Interior		18	S/S	4
b. Exposed Exterior		18	S/S	7
c. Unexposed exterior		18	Galv.	-
d. Perforated False Bottom		16	S/S	4
8. Legs & Crossrails, tubing		16	S/S	4
9. Shelf Brackets:				
a. Exposed		14	S/S	4
b. Unexposed		14	Galv.	-
10. Shelves:				
a. Wall mounted		16	S/S	4
b. heated		14	S/S	7 (edges)
c. Table		16	S/S	4
d. Refrigerator		18 perf. or	S/S Wire	
11. Sinks:				
a. Sink Basin & drainboard		14	S/S	4

b. Reinforcing Plate	14	S/S	2B
c. Waste Handle Bracket	14	S/S	4
12. Wall Flashing	20	S/S	4

4.2 METAL TOPS

A. Metal tops to be constructed with 3/4"(19mm) or larger radius bends (coved corners) at all backsplashes and turned up edges in all horizontal and vertical corners.

B. Tops made up of multiple sheets shall have all joints and seams continuously welded, ground smooth and polished to blend with adjacent surfaces. Metal surface grain on adjacent sheets to be aligned wherever possible.

4.3 BRACING

A. Tops shall be secured to a full perimeter 4" X 2" (100 X 50mm) hat channel frame, fully welded, with cross-bracing not more than 30" (760mm) on center. Tops 3'-6" (1060mm) or deeper shall have an additional hat channel running lengthwise. Fasten top with stud bolts or tack welds. Close ends of all inverted channels.

B. Tops supporting overshelves, coffee urns, tea urns, hot water boilers, ice dispensers or other heavy equipment shall be 12 ga stainless steel and have 12 ga welded bracing not more than 15” (380mm) on centers to support the heavy loads.

C. Heated counter tops shall be 12 ga stainless steel and reinforced and tack welded to 12ga L channels on 15” centers, with welds every 2” inches.

4.4 EDGES

A. Worktables and counter tops shall have bull-nosed rolled edges minimum 1 1/2” (40mm) fully returned and sealed to cabinet body unless otherwise noted.

B. Sinks, dishtables and drainboards to have raised rolled rims unless otherwise noted.

C. Corners shall be bull-nosed, welded, ground and polished to match adjacent surfaces.

4.5 SOUND DEADENING

A. Coat underside of all metal tops with a minimum 1/16"(2mm) thick approved hard-drying, sound-deadening mastic materials. Apply by spraying after top has been secured to frame, so that top and frame are covered and sealed. Verify with local health department that this practice is acceptable.

4.6 WOOD TOPS

A. Wood Tops constructed of kiln dried maple strips minimum 1 1/2” (40mm) thick. Tops shall be resin-bonded laminations, Michigan Maple, John Boos or equal. Wood top coves to be 1” (30mm) radius or greater.

4.7 ENCLOSED COUNTER BASES

A. Bases made of steel sheets reinforced by forming and welding the metal. Vertical ends and partitions are to be double wall construction minimum 2" (50mm) wide. Sides and through partitions are to be flush with bottom rail, welded at intersections. Ends, partitions and shelves are to be all stainless steel. Unexposed backs and structural members may be galvanized

.

B. Bottom front rail of bases set on masonry platform shall be continuously sealed base, provide front rail

closure section.

4.8 FIELD JOINTS

A. Field joints, where required due to limitation of sheet sizes, equipment sizes or installation requirements, shall be welded, leveled, tacked down, ground smooth and polished to blend with adjacent surfaces.

4.9 SHELVES

A. Shelves in counters with enclosed bases to be turned up a minimum of 2" (50mm) at back and sides with 1/2" (12mm) radius and feathered slightly to ensure a tight fit to walls, partitions and backs. Bottom shelves to be removable when the counter is mounted on a concrete pad or metal base. Bottom shelves to be fixed when counter is mounted on legs. Intermediate shelves to be fixed except when removal is required for utility access or unless otherwise noted.

B. In items with open bases, turn up back and sides 2" (50mm). Notch around legs and continuously weld at all intersections including front and turn-up.

4.10 TUBING LEGS AND CROSSRAILS

A. Legs shall be 1 5/8" (40mm) 16 Gauge stainless steel tubing unless, noted otherwise. Tops of legs to be fitted to leg sockets that are welded to the hat channel frame. At sinks, weld leg socket to triangular plate gusset.

B. Crossrails shall be 1 5/8" (40mm) 16 Gauge stainless steel tubing, unless noted otherwise, continuously welded to legs. Welds to be ground smooth to match adjacent surfaces. Tack welds are NOT acceptable.

4.11 DRAWERS

A. Drawer fronts to be double pan stainless steel construction. Outside pan to have corners welded, ground smooth and polished. Inner pan to be fitted tightly into outer pan. Drawer front to be filled with rigid sound deadening material such as Celotex or Styrofoam if non-refrigerated, polyurethane if refrigerated. Thickness of finished drawer front to be approximately 3/4" (19mm) for non-refrigerated, 1” for refrigerated drawers, unless otherwise noted. Drawer front to be fully welded to angle frame pan support.

B. Pan support to be 14-ga stainless steel, welded continuous channel cradle (carriage) frame and shall support drawer pan on all four sides. Frame to be supported by full extension heavy-duty slides Component Hardware S52 series slides or better. Slide wheel assemblies to be welded, not bolted to frame. Pan frames to have bottom panel turned up and welded to sides for increased rigidity.

C. Slides to be full extension, 200 pound (91kg) capacity, stainless steel with stainless steel ball bearing wheels. Size slides for easy removal of drawer pans. Drawers to be self-closing.

D. Provide a replaceable rubber bumper on each interior corner of non-refrigerated drawers, Component Hardware, #Q26-4071

.

E. Drawer pans to be removable N.F.S. approved A.B.S thermoplastic with smooth interior, unless otherwise noted. Drawers in refrigerated cabinets shall be three per section and sized to accommodate 12”x20”x6” deep hotel pans, or by use of adapter bars, smaller standard size pans.

F. Drawers in refrigerated section, unless otherwise specified, shall be furnished with magnetic, vinyl-latex, gray, full perimeter removable gasket. Gasket must mount with no gaps or bulges. Gasket to be easily removable with hand tools. Do not use pop rivets.

4.12 DOORS

A. Metal hinged and sliding doors to be double pan, stainless steel construction unless otherwise noted. Outside pan to have corners welded, ground smooth and polished. Inner pan to be fitted tightly into outer pan with rigid sound deadening material such as Celotex or Styrofoam. Thickness of finished door front to be approximately 3/4" (19mm) for non-refrigerated, 1” for refrigerated, unless otherwise noted. Provide reinforcing to prevent flexing.

B. Sliding doors to be double pan, stainless steel construction, self-closing and removable without the use of tools. Outside pan to have corners welded, ground smooth and polished. Inner pan to be fitted tightly into outer pan with rigid sound deadening material such as Celotex or Styrofoam if not refrigerated, polyurethane if refrigerated. Thickness of finished drawer front to be approximately 3/4" (19mm) unless otherwise noted. Provide reinforcing to prevent flexing or warping. Doors to mount in 14 Gauge stainless steel channel tracks top and bottom. Door to slide on top- and bottom-mounted UHMV glides to be approved by MÜLLER DESIGN INC. UHMV strips to be removable on bottom tracks.

C. Wood core doors to be stainless steels single pan with 3/4" (19mm) plywood insert faced with plastic laminate. Pan to have corners welded ground smooth and polished.

D. Doors to be flush with mullions.

4.13 ACCESS PANELS

A. Access panels to be single pan stainless steel construction unless otherwise noted. Corners to be welded and ground smooth. Reinforce door by forming metal back against inside face and welding.

4.14 SINKS

A. Fabricated sinks shall have coved interior corners same as for metal tops complying with local codes. All sinks shall be one piece-welded construction with bottoms pitched to drains and double wall partitions. Multiple compartments shall have continuous exteriors. Opening between compartments or applied panel will not be accepted.

4.15 ICE PAN/ICE BINS & REFRIGERATED PANS

A. All ice pans, ice bins, refrigerated pans and cabinets shall be provided with 1/8" (3mm) breaker strip where adjoining top or cabinet face in order to prevent condensation. Secure with countersunk stainless steel screws (pop rivets are not acceptable).

B. Sides to have 1" (25 mm) minimum thick insulation. Bottoms to have 2" (50mm) minimum thick insulation.

C. Insulation to be enclosed on all sides with stainless steel if exposed or galvanized if unexposed.

4.16 INSULATION

A. Insulation shall be minimum of 1" (25mm) fiberglass for heated areas. Board form, or foamed in place polyurethane, in thickness as indicated on details or drawings shall be used for all cold areas. Bond insulation to all surfaces.

4.17 REFRIGERATED COMPARTMENTS

A. Openings shall be provided with a 1/8" (3mm) breaker strip where adjoining top of cabinet to eliminate temperature transfer and prevent condensation.

B. Interior shelves to be adjustable stainless steel wire construction or perforated pan construction mounted on removable stainless steel angle guides (see Standard Detail SD-014.) Removable thumbscrew type pilasters are not acceptable.

C. Bottom to be fitted with stainless steel wire rack or perforated pan set on liner.

D. All evaporators shall be installed for accessibility and replacement. Coordinate location with refrigeration contractor.

4.18 EXPANSION VALVE HOUSING

A. When expansion valve is removed from the evaporator, all refrigerated shelves or pans, or refrigerated compartments shall be provided with a 20 gauge stainless steel box to house expansion valve. Install in a concealed, but accessible position. Verify clearance for shelving, drawers or sheet pans before mounting.

4.19 DUCTS

A. Exposed duct work and trim to be fully welded grease or watertight as the application requires.

4.20 FASTENERS

A. Exposed bolt heads will not be permitted on fixtures.

B. Butt joints made by riveting straps under seams and then filled with solder are not acceptable.

C. Rivets of any kind, including pop-rivets, are not acceptable.

D. Exposed screw heads when necessary, shall be of the same material as the exposed surface and countersunk flush.

4.21 WELDING

A. All seams and joints shall be welded as the nature of the material requires to blend and match.

B. Exposed welds are to be continuous, strong ductile with excess metal ground off. Polish to match and blend with adjacent surfaces.

C. Welds on galvanized steel shall be smooth and strong. Remove all slag and carbonization. Where galvanizing has been burned off, touch up on both sides with high-grade aluminum paint.

D. Exposed spot welds to be polished to match and blend with adjacent surfaces. Exposed dimples are not acceptable.

E. Exposed dimples from welding studs on underside of tops other surfaces are not acceptable. Polish surface to match and blend with adjacent surfaces.

4.22 HEATING EQUIPMENT

A. Electric heating equipment shall be so installed as to be readily cleanable or made easily removable for cleaning.

B. Gas operated and/or heated equipment, fabricated or otherwise, shall conform to the lateAst standards and comply with National Safety Requirements of the American Gas Association, or be acceptable to authorities having jurisdiction.

C. Steam heated custom-fabricated equipment shall be complete with control valves located in an accessible

position.

4.23 PANS AND INSERTS

A. All cutouts, openings, drawers, or equipment specified or detailed for stainless steel pans shall be provided with 20 gauge, minimum, stainless steel solid insert pans for each space. Size as per specification, plans or details. Provide maximum depth pan to suit application and space, unless otherwise noted. Provide 18 gauge stainless steel adapter bars if required.

PART 5 - ELECTRICAL

5.1 PERMITS

A. Contractor shall obtain and pay for permits and fees for inspection and approval of fabricated equipment electrical work. Wiring shall be inspected and approved before being concealed by cover panels as required by code or permit conditions.

5.2 PRE-WIRED ITEMS

A. Fabricated equipment with either inaccessible connections, two or more receptacles or connections, shall be pre-wired ready for final connection to building services by Electrical Contractor.

B. Contractor shall supply and install conduit, wiring controls, switches, receptacles, junction boxes, service fittings, etc. to interconnect all electrical components to a single junction box or breaker panel. Such work shall conform to NEMA standards and local codes. Components are to have local approval and shall be in accordance with the electrical code in effect at the job-site.

C. Where field joints are required, break electrical wiring with a junction box on one side and conduit on other side which can be joined to box. Wire to be color-coded or tagged to facilitate connecting wires in junction box by Electrical Contractor.

D. Sub-panels where required shall be UL listed, 3 phase, 4-wire circuit breaker type with a ground buss main breaker and individual breakers for each serviced load. All buss shall be copper and the circuit breakers shall be molded-case bolt-on type with thermo-magnetic quick-make, quick-break trip. Multi-poled circuit breakers shall have an internal trip bar. Each breaker shall be sized for 125% of the connected load. A minimum of two extra single pole, 20 amp breaker sites will be provided. The loads shall be connected through the breakers in a phased sequence to balance the load on each phase.

E. Each breaker panel to include an index card behind heavy clear plastic in card holder inside of door. Type all circuit information on card clearly identifying the equipment served by each circuit breaker.

5.3 WIRING

A. Wire shall be U.L. or E.T.L. approved for use in various applications, such as nickel for heat, nichrome for resistance wiring, etc. selected for appropriate voltage, temperature and location.

B. Provide nickel-plated insulated wiring for heated areas.

C. Wiring shall be color coded to match those in effect at the job-site.

5.4 CONDUIT

A. Conduit shall be run concealed wherever possible, Conduit shall be continuous from outlet to outlet. Secure to junction boxes, pull boxes and breaker boxes so that each circuit is continuous throughout. Support conduit to prevent vibration and sagging.

B. Concealed conduit to be EMT, thin wall, with compression fittings. If codes allow, "Seal-Tite" flex conduit

may be used in lieu of EMT.

C. Exposed or conduit in wet areas to be "Seal-Tite" type equal to Anaconda #UA complete with threaded and gasketed J-boxes, pull boxes and liquid tight connectors.

D. Conduit and wire for computer equipment (cash registers, pre-check registers, remote printers, ticket printers, etc.) shall NOT be run in a heat zone. Type, gauge and specifications shall be provided by POS system provider.

5.5 HEATING ELEMENTS

A. Insulated heated bases. Chromalox, Type OT, 1-1/2" (38mm) strip heaters with chrome steel sheath shall be acceptable when sized and located to provide NSF standard levels of heat. Length to suit application. Verify electrical requirements with plans and details.

B. Steam Tables & Bain Maries. Chromalox, Type TTUH-CO, immersion heater with low water cut-off, brass flange, gasket and clamp shall be acceptable when sized and located to provide NSF standard levels of heat. Verify electrical requirements with plans and details.

C. Controls. Chromalox, Type ARR, non-indicating temperature controller with pilot light. Mount controller in a terminal box with a removable access cover located outside the heated area

.

D. For bain marie and steam tables, provide Style 9 bulb and capillary with type 300, stainless steel compression fitting. For heated base, use Style 4 or Style 5 bulb and capillary. Mount capillary on side wall positioned for average temperature reading.

5.6 CONVENIENCE AND POWER OUTLETS

A. All surface mounted receptacles and receptacles under open table tops for fabricated equipment are to have T&S Brass &, Bronze Works Series B-1500 aluminum box complete with satin finish stainless steel cover and receptacle as indicated below:
   1. 2-pole,3-wire grounding 20 amp-, 125V.
   2. Hubbell #5352 or equal (NEMA 5-20R).
   3. 2-pole, 3-wire grounding 20 amps, 250V.
   4. Hubbell #5461 or equal (NEMA 6-20R).
   5. 2-pole, 3-wire grounding 30 amp 250V.
   6. Hubbell #9330 or equal (NEMA 6-30R).

B. All built-in receptacles indicated for fabricated equipment are to be 2"x4"x2” deep "Handy Box" tack welded to fixture and fitted with receptacle indicated above and satin finish stainless steel cover. Mounted all receptacles horizontally.

5.7 CORDS AND PLUGS

A. For plug-in equipment, furnish and install cord and plugs conforming to NEMA standards. It shall be the Contractor's responsibility to coordinate with the Electrical Contractor so that the plugs match the receptacle. Any changes in cords and plugs required in the field due to lack of coordination shall be made at no additional cost.

5.8 LIGHTS AND FIXTURES

A. Provide light receptacles, shatterproof lamps and automatic door switches for custom fabricated and standard refrigerator units and sections.

B. Where fluorescent light fixtures are specified or detailed as parts of equipment, all ballasts shall be included. All lamps for fluorescent light fixtures shall be provided and installed by this contractor and are to be supplied in "Warm White" DELUXE, or as specified in plans and drawings. Bulbs for incandescent light fixtures in equipment shall be supplied by the Contractor. Provide shatterproof lamp protectors over tubes and bulbs where required by code.

C. Where light fixtures or other electrical fixtures are specified or detailed as part of cabinets, the contractor shall provide all necessary lamps, ballasts, conduit and wiring to junction box within 24" of building J box. Equipment J box to be accessible for final connection by Electrical Contractor.

5.9 IDENTIFICATION

A. All switches, controls, etc., shall be conspicuously labeled as to use with plastic nameplates screwed to adjacent surfaces, with white recessed lettering on black background. Submit a sample to MÜLLER DESIGN ASSOCIATES for review.

PART 6 - PLUMBING

6.1 PRE-PIPED ITEMS

A. Pre-pipe components for fabricated equipment complete with all required valves, unions, nipples and fittings required ready for final connection to building services by the Plumbing contractor. Faucets, rotary wastes and basket wastes to be furnished loose for installation by plumbing contractor.

B. Large equipment such as cafeteria counters, chef's counters, and ventilators shall be delivered in pre-piped sections complete with unions for interconnecting sections. Plumbing contractor to make connections between sections.

C. Water piping to be type "L", hard drawn, copper with wrought copper fittings. Joints to be soldered with lead free solder. All runs to be made with full-length sections or lengths cut to fit. Pipe size may not be decreased from those indicated. Secure piping to prevent transmission of noise. Insulate hot water lines. Insulate cold water lines, if required, to prevent condensation

.

D. Water inlets shall be located above the positive water level wherever possible. Wherever conditions shall require a submerged inlet, a suitable type of check valve (if permitted by code) and vacuum breaker shall be provided with the fixture to prevent siphoning. Where exposed, all piping shall be chrome plated. Where penetrations are made through equipment for vacuum breakers or connections, provide escutcheons matched to adjacent finishes to cover holes.

6.2 STEAM

A. Provide all composition hand wheels, solenoid gate valves, strainers, condensate traps, temperature controllers, check valves and interconnecting piping. Piping within fixtures to be schedule 40, black iron including nipples and fittings. Insulate per accepted industry practice except for areas exposed for heating.

B. Kettles to be provided with a pre-piped steam trap assembly per itemized specifications. Assembly to be furnished to plumbing contractor for installation.

6.3 COMPONENTS FURNISHED LOOSE

A. Furnish to the plumbing contractor all item related faucets, hose reels, vacuum breakers, pressure reducing valves, rotary wastes and basket wastes.

B. Coordinate the installation of the above with the plumbing contractor.

6.4 FAUCETS

A. Furnish faucets with soft-flo heads on sinks, steam table, bain maries, water stations and other equipment as shown on plans, details and specifications. Furnish water saving devices where required by local codes. Faucet handles to be appropriately marked hot or cold as the application requires. Unless specified otherwise, faucets shall be by Component Hardware Group or T&S Brass.

6.5 WASTES

A. Provide rotary twist type Component Hardware Group DSS-8000 with flat stainless steel strainer shall be provided unless otherwise specified. Furnish with all required hardware, mounting plates and adapters.

B. Standpipes. Provide Fisher Model 6271, 1" diameter polished chrome standpipe with Model 6342-2300 waste socket complete with lock nut. For applications with a depth of more than 7"(175mm) provide Fisher Model 6571, 1 1/2"(38mm) polished chrome standpipe with Model 6542-2300 waste socket complete with lock nut.

C. Secure waste socket with lock nut and solder top flange to exposed top surface.

D. Standpipe length to be 3" below top of counter or per detail. Verify length required
.

E. Open drains. Provide Fisher Model 6242, 1" (25mm) polished chrome complete with brass lock nut. Solder top flange to exposed top surface.

6.6 INDIRECT WASTE

A. Furnished and installed by the Plumber, with the following exceptions:

1. Contractor to furnish indirect wastes for cold storage room evaporators.

2. Contractor to Provide and install indirect waste lines from equipment drains in the factory if drains are not easily accessible in the final placement in the field. Plumber fwill continue connection to floor sinks or stand pipes with chrome plated connections where exposed. Secure all piping and support to equipment without marring or damaging framing or finishes.

B. Contractor to coordinate the location and routing.

C. Indirect wastes shall be sized as shown on drawings, hard copper, 1" diameter minimum. Drain lines within fixture shall be routed as high as possible and conform to fixture configuration and functions, so as to not obstruct openings or shelves.

6.7 VACUUM BREAKERS

A. Furnish item related chrome plated vacuum breakers with exposed piping to equipment. Exposed piping to be chrome plated. Verify type required with codes
.

1. Atmospheric type to be Febco or equal.

2. Pressure type to be Fisher, Watts or equal.

6.8 PRESSURE REDUCING VALVES

A. Furnish pressure-reducing valves, when required for item related equipment.

6.9 GAS PRESSURE REGULATORS

A. Furnish gas pressure regulators for all gas fired equipment.

6.10 QUICK DISCONNECTS

A. Gas. Provide Dormont Manufacturing Company, (unless otherwise specified), or equal, BPQ series, flexible connector kit complete with gas ball valve, BPQ connector, BPQ quick disconnect coupling and coiled restraining devices.

B. Water. Dormant Manufacturing Company, (unless otherwise specified), or equal, BP series, stainless steel braid over hose flexible high PSI connector with solid brass two way quick disconnect coupling.

C. Coordinate pipe size with equipment and plans. Length to be sufficient to move equipment for cleaning and to provide easy access to quick disconnect.

D. Provide restraining cords of suitable strength and size as required by code where ever flexible connections are used.

6.11 FLEXIBLE WATER CONNECTOR

A. For counter equipment requiring water connection in public areas, provide Fisher Model 2903 through counter fitting and Koroseal tubing covered with stainless steel braid, stainless steel coupling at fitting and angled stainless steel fitting at appliance.

PART 7 - REFRIGERATION

7.1 REFRIGERATION SYSTEM REQUIREMENTS

A. Provide all refrigeration work through licensed refrigeration contractors. All existing equipment shall be suitably drained of refrigerants in an approved method and reclaimed. No R-12 shall be used.

B. All refrigeration items shall be designed to maintain the following operating temperatures:

1.	Walk-in refrigerators	35ºF/1.7ºC
2.	Walk-in Freezers	-10ºF/-23.3ºC
3.	Reach-in refrigerators	35ºF/1.7ºC
4.	Reach-in freezers	-10ºF/-23.3ºC
5.	Under-counter refrigerators	35ºF/1.7ºC
6.	Under-counter freezers	-10ºF/-23.3ºC
7.	Cold pans	0ºF/-17.8ºC
8.	Work/wine rooms	50ºF/10ºC

C. An evaporator coil defrost system must be provided by the Contractor on all walk-in refrigerators and freezer rooms operating at less than 35ºF/1.7ºC.

D. Hang blower coils per manufacturer's specifications with approved hangers at 4" from interior walk-in ceiling. Contractor shall provide #12 ga galvanized steel fish plate of suitable size and shape on the exterior roof of the walk-in above the coil to support and spread the weight of the coil adequately.

E. Drain line from freezers shall be wrapped with a continuous electrical heater tape and installed per manufacturer's suggested methods.

F. Refrigeration tubing shall be Type L, ACR hard drawn degreased, sealed copper and shall be installed with horizontal runs sloped 1" per 20 feet towards the condensing units. All refrigerant piping shall be properly supported by adjustable hangers spaced and adjusted to the drop required. Where vertical runs of more than 5' occur in the suction line, the risers shall be trapped at the bottom. Piping is to be installed so that the refrigerant or oil cannot drain back into the coil from the suction line.

G. All suction and refrigerant lines shall be insulated with minimum 1/2" Armstrong armaflex or equal cellular type insulation. Metal pipe sleeves shall be provided where piping passes through walls, ceilings or floors. Space around the tubing shall be filled with mastic insulating compound. Install a permanent suction line filter in each compressor suction line with pressure fitting ahead of the filter to facilitate checking of the pressure drop through the filter. All penetrations through walk-in or freezer walls shall be fully insulated and sealed to be vapor tight to prevent condensation within any light fixtures, switch boxes, junction

boxes, or any other fittings. Refrigeration and drain lines shall be fully sealed and provided with escutcheon plates by the installer per attached standard detail or better.

H. Furnish and completely install a thermostat to control the refrigeration temperatures for each refrigeration compartment. Provide clear dial thermometers mounted flush with each compartment reading in both Fahrenheit and Centigrade.

I. Control and thermostat wiring is the responsibility of the Contractor, not the electrical contractor. The electrical contractor will provide inter-wiring between the freezer condensing units and freezer blower coils as well as the main power to all disconnects on condensing units and racks.

J. All refrigeration parts, equipment and labor are the responsibility of the Contractor whether subcontracted or not. All refrigeration lines, placements, hangers, insulators, connections and refrigerants are considered parts and must be made available to complete and deliver a fully installed system in working operation at the required temperatures.

PART 8 - VENTILATION

8.1 NON-WATER WASH VENTILATORS

A. GENERAL: Each ventilator shall be a high velocity centrifugal grease extractor, with the air inlet opening parallel to and above the cooking equipment being ventilated. The ventilator shall contain one or more removable "extractor inserts" with a grease extraction efficiency of 90% when operated at design conditions. All extractor inserts shall be constructed of stainless steel and contain full-length self-draining baffles. All extractor inserts shall be easily removable, with the use of an extractor removal tool, for periodic cleaning. The grease-collecting gutter at the bottom of the extractor housing shall slope to one end to a removable, stainless steel grease-collecting container. A built in 3" air space from the back of the extractor and exhaust plenum to the back mounting surface shall be an integral part of the hood assembly. Vertical seams on the end panels indicating 3" spacers are unacceptable. Where the end of the hood abuts a wall, there shall be a 3" air space as an integral part of the hood and there shall be no vertical seams in the front face of the hood indicating air space on the ends of the hood. The canopy shall contain a minimum of 6" clearance between the back of the exhaust duct connection and the back wall of the ventilator. The six-inch clearance shall be provided for ease in mounting and the installation of a rated enclosure around the duct. Removable or hinged access doors located in the roof of the canopy for the purpose of accessing the damper/thermostat control mechanism if required, shall be approved as part of the listing for the ventilator. Proof of such listing shall be provided as part of the ventilator shop drawings. Exposed conduit, cables, or piping will not be allowed within the ventilator canopy, with the exception of chrome sleeved piping drops from the canopy roof for the surface fire suppression system. All ventilators and pollution control equipment shall be built by the same manufacturer and shall have been in satisfactory use on similar installations for a period of three years prior to the bid date for this project. Equipment provided by separate manufacturers will not be acceptable. Listings of (four) previous successful installations of a similar type shall be provided with equipment shop drawings.

B. CONSTRUCTION: The ventilator shall be of all stainless steel construction, not less than 18 gauge, type 304. All exposed surfaces shall be a number 4 finish. The use of the galvanized material in any part of the ventilator is not acceptable. The use of '400' series stainless in any part of the ventilator is unacceptable.

C. INTERNAL FIRE PROTECTION: Ventilator shall be equipped with a spring loaded fire damper located at the duct collar. The fire damper shall be thermostatically activated and upon activation at 280° F, the damper shall close and the exhaust fan shall shut off. The fire damper shall be able to be reset with a single reset handle located beneath the canopy. The reset device must be easily reached from the front of the ventilator, without the use of tools.

D. MULTIPLE SECTIONS: The canopy profile shall be continuous for each ventilator. The use of partitions or end plates where sections are joined (which would be contained within the canopy where multiple sections of ventilator are joined to form a single, longer ventilator) will not be acceptable. The method of joining separate ventilator sections shall be part of the listing of the ventilator, and proof of the listing must be included as part of the ventilator shop drawings.

E. ELECTRICAL: All ventilators shall be factory pre-wired to a single field connection point. Any ventilators built in multiple sections shall be furnished with junction boxes for field connections by applicable trades.

F. LIGHT FIXTURES: Ventilators shall be equipped with 150 watt recessed incandescent lights. All lights shall be UL Listed for Commercial Kitchen Hoods and shall be factory pre-wired to a single connection point. All wiring shall be factory installed and terminated in junction box(es) for field connection by others, for multiple section ventilators.

G. APPROVALS: All ventilators shall be UL Listed under the category "Exhaust Hood with Fire Damper" and shall be NSF listed. Ventilator shall meet all requirements of NFPA-96, UMC, BOCA and SBCCI mechanical codes. Agency approval listings do not release the manufacturer from meeting the construction and performance requirements set forth in the specifications for the ventilators. Proof of listing(s), although required, does not imply acceptability or approval of the ventilator.

H. CHECK OUT AND DEMONSTRATION: Upon completion of the installation, the entire ventilation system, including the pollution control equipment, is to be commissioned by a direct factory employed service technician. Start-up procedures shall include the taking of air volume readings and running the system through wash and a fire cycles. Kitchen personnel shall be given a complete demonstration of the system, including operation and maintenance procedures. Upon completion of the commissioning, a detailed start-up report shall be made available to the architect and owner certifying proper system operation. All deficiencies in wiring or piping which are contained within the equipment, and which are discovered during start-up, shall be corrected at no additional expense to the owner.

PART 9 – SCHEDULED EQUIPMENT

All items listed are to be priced individually by item number, with each price reflecting total cost of item with all options and specified modifications

SERVERY

Area "C" Numbers: C01 through C18

C01 Entrée Counter (mobile) Two required GCF/GCI

General contractor to furnish one (2) each custom fabricated counter, sized as shown in drawings and with the following:

1. Provide custom fabricated counter shown in drawings with stainless steel framing body.
2. Provide doors as shown
3. Provide casters as required to support unit.
4. Fabricator to provide shop drawings for approval by consultant.

C02 Sneezegurards (movable) Four required KECF/KECI/GCI

Furnish four (4) lot Brass Smith, model Z Guard ZG7600 series custom breath guard, complete per manufacturer's standard specifications and the following:

1. Furnish all posts, glass etc. for lengths of sneeze guards as indicated per plan sheet FS3.0.. Fabricate/provide sneeze guards required to provide adequate food protection per Health code requirements.
2. Post to be Stainless Steel.
3. All glass panels to be minimum 3/8" thick tempered glass.
4. Unit to be portable
5. These assemblies are custom fabricated in nature. KEC / BSI is required to provide shop drawings for approval by consultant, prior to fabrication. All drawings to show, at a minimum in plan view, the equipment items (below) that are covered by the sneeze guard. Side views to indicate compliance with California code 54"/60" rule for sneeze protection.
6. BSI/KEC to provide shop drawings

C03 Induction Unit Eight required KECF/KECI

Furnish eight (8) each Cooktek model TBD, induction unit, complete per manufacturer's specifications.

C04 Counter (mobile) Two required GCF/GCI

General contractor to furnish one (2) each custom fabricated counter, sized as shown in drawings and with the following:

1. Provide custom fabricated counter shown in drawings with stainless steel framing body.
2. Provide doors as shown
3. Provide casters as required to support unit.
4. Fabricator to provide shop drawings for approval by consultant.

C05 Dispenser One required KECF/KECI

Furnish one (1) each Crysalli model CBR-V3, dispenser, complete per manufacturer's specifications.

C06 Undercounter refrigerator One required KECF/KECI

Furnish one (1) each True Model TUC-27, undercounter refrigerator, complete per manufacturer's specifications.

C07 Coffee brewer system One required KECF/KECI

Furnish one (1) each Rancilio model EGRO One Touch- Milkk PX NMS, coffee brewer system, complete per manufacturer's specifications.

C08 Soda Dispenser One required KECF/KECI

Furnish one (1) each Coca Cola model Freestyle soda dispenser, complete per manufacturer's specifications.

C09 Air Curtain Display Case Two required KECF/KECI

Furnish one (1) each Infrico model IAG-EML-9INOXM1, air curtain display case, complete per manufacturer's specifications.

C10 Water filter One required KECF/KECI/GCI

Furnish one (1) each Everpure model High Flow EV943730, water filter system complete manufacturer's standard specifications and the following:

1. Mount unit as shown on drawings.
2. Provide all required mounting and connection parts.
3. Provide as part of this item, two replacement filters for each filter supplied as part of model number.

C11 Spare number

C12 Spare number

C13 Hot/Cold Transport Carts Five required KECF/KECI

Furnish five (5) each Cambro model CMBHC1826TBF, hot cold hodling carts, complete per manufacturer's specifications.

C14 Prep Table with sink One required KECF/KECI/GCI

Furnish one (1) each custom fabricated worktable sized as shown in drawings per standard details sheet FS7.0, SD001 and the following:

1. Reinforce full length of top with inverted hat channel.
2. Provide 14ga construction.
3. Legs to be 1 5/8" 16 Ga. s/s tubular type with fully welded with CHG Model AYE type or better
4. Provide one (1) prep sinks 20”x20”x14” with twist type lever wastes
5. Fabricator to provide shop drawings for approval by consultant.

C14A Faucet One required KECF/KECI

Furnish one (1) each T&S, model B-0221-CC, faucet, complete per manufacturer’s specifications.

C15 Smart Wall Shelving One lot required KECF/KECI

Furnish one lot each Metro model TBD, smart wall shelving, complete per manufacturer's specifications.

C16 Beverage Counter One required GCF/GCI

General contractor to furnish one (2) each custom fabricated counter, sized as shown in drawings and with the following:

1. Provide custom fabricated counter shown in drawings with stainless steel framing body.
2. Provide doors as shown
3. Fabricator to provide shop drawings for approval by consultant.

C17 Freezer One required KECF/KECI

Furnish one (1) each True Model TUC-27F, Freezer, complete per manufacturer's specifications.

C18 Undercounter freezer One required KECF/KECI

Furnish one (1) each True Model TUC-27F, undercounter freezer, complete per manufacturer's specifications.

Area "E" Numbers: E01 through E17

E01 Vapor Hood One required KECF/KECI/GCI

Furnish one (1) each Streivor Air, model TBD,, vapor hood, complete per manufacturer's specifications with duct connection sizes, CFM, static pressure, electrical requirements as noted on plan Unit to include the following:

1. Ventilators to be "box" shape in lieu of sloping sides.
2. Center duct location.
3. Aluminum perforated filter.
4. Final length of hood shall be verified with building "for construction" plans before release for fabrication.
5. Ventilator to be installed at 7'0" above finished floor.
6. Foodservice equipment contractor to provide all required 20 ga. s/s filler panels and trim pieces to enclose to ceiling or soffit line above and to either side.

E02 Warewasher One required KECF/KECI/GCI

Furnish one (1) each Champion, Conveyor Type, model 44-PRO adjustable conveyor speed, approximately 248 racks/hour hi-temp sanitizing rinse, single tank design (wash), 25" clearance through machine, stainless steel construction, recirculated hot water tank heat, booster heater, vent fan control specifications standard specifications and the following:

1. Left to right operation, configuration per plans.
2. Provide stainless steel enclosed top-mounted control panel.
3. Provide stainless steel pumps and impeller.
4. Provide common drain connection to load end.
5. Unit to be wired for 208 volt 60hz, 3 phase operation.
6. Provide all required connections to and from dishtables.
7. Provide water pressure reducing valve and hammer arrestor.
8. Provide factory authorized start-up and demonstration
9. Provide built in booster heater

E03 Soiled dishtable One required KECF/KECI/GCI

Provide one (1) each Champion, custom fabricated soiled dishtable sized as shown in drawings and in Standard Details, sheet

1. Turn up all exterior edges in 3" turn up terminating in a 180° bullnose turn-down, except at walls.
2. Provide 14" splash at wall with 45° top angled back to wall and 1" turn down to wall and back to wall by 1" at exposed ends.
3. Leg mount channels to be stud bolted to underside of top to accommodate s/s welded gusset plates. Legs to be 1 5/8" 16 ga s/s tubular type reinforced with fully welded cross-braces and with CHG Model AYE type or better heavy duty feet with 3" adjustment.
4. Mount wall side to wall with Z-clips.
5. Corner roller section
6. Scraping holes with rubber scraping blocks.
7. Fabricator to provide shop drawings for approval by consultant.

E03A Two tiered drop off shelving in framed wall opening One required KECF/KECI/GCI

Provide one (1) each Champion, custom fabricated drop off shelivng sized as shown in drawings and in Standard Details, sheet

1. Turn up all exterior edges in 3" turn up terminating in a 180° bullnose turn-down, except at walls.
2. Mount wall side to wall with Z-clips.
3. Fabricator to provide shop drawings for approval by consultant.

E03B Pre-rinse with faucet — One required — KECF/KECI

Furnish one (1) each T&S, model B-2261-12-CR-B, pre-rinse with faucet, complete per manufacturer's specifications.

E04 Clean dishtable with rollers/shut-off switch — One required — KECF/KECI/GCI

Provide one (1) each Champion, custom fabricated clean dishtable with rollers/shut-off switch sized as shown in drawings and in Standard Details, sheet

1. Connect to item E02.
2. Provide roller table section per drawings
3. Leg mount channels to be stud bolted to underside of top to accommodate s/s welded gusset plates. Legs to be 1 5/8" 16 ga s/s tubular type reinforced with fully welded cross-braces and with CHG Model AYE type or better heavy duty feet with 3" adjustment.
4. Mount to wall side with "Z" clips.

E05 Wall Shelf — Two required — KECF/KECI

Furnish two (2) each Advance model PS-18-48, wall shelf, complete per manufacturer's specifications.

E06 Floor Trough — Two required — KECF/KECI

Provide two (2) each custom fabricated floor trough sized as shown in drawings and in Standard Details, sheet

1. Fabricator to provide shop drawings for approval by consultant.

E07 Floor Trough — One required — KECF/KECI

Provide one (1) each custom fabricated floor trough sized as shown in drawings and in Standard Details,sheet.

1. Fabricator to provide shop drawings for approval by consultant.

E08 Three compartment sink — One required — KECF/KECI

Furnish one (1) each Advance Tabco Model 94-83-60-36RL, three compartment sink, complete per manufacturer's specifications.

E08A Splash mount faucet 12" spigot — One required — KECF/KECI

Furnish one (1) each T&S, model B-0231-B-WH6, faucet, complete per manufacturer's specifications.

E08B Pre-rinse with faucet — One required — KECF/KECI

Furnish one (1) each T&S, model B-2261-12-CR-B, pre-rinse with faucet, complete per manufacturer's specifications.

E09 Barred wall shelves — Two required — KECF/KECI

Provide two (2) custom barred wall shelving sized and shaped as shown in drawings and the following and Standard Details sheet

1. Frame to consist of 16ga s/s 1" minimum box tubing supported by 12ga 14" deep by 10" tall brackets.
2. Shelf to consist of 1" OD 16ga tubular s/s bars sized and configured as shown in Standard
3. Brackets must mount to wall with welded flange with four anchoring holes. Contractor to provide anchoring bolts.
4. Contractor to verify mounting height.
5. Fabricator to provide shop drawings for approval by consultant

E10 Spare number

E11 Spare number

E12 Spare number

E13 Pot rack — One required — KECF/KECI

Provide one (1) custom pot rack sized and shaped as shown in drawings and the following and Standard Details sheet

1. Frame to consist of 16ga s/s 1" minimum box tubing supported by 12ga 14" deep by 10" tall brackets.
2. Brackets must mount to wall with welded flange with four anchoring holes. Contractor to provide anchoring bolts.
3. Contractor to verify mounting height.
4. Fabricator to provide shop drawings for approval by consultant

E14 Hand sink, wall mount, knee valve/side splashes — One required — KECF/KECI/GCI

Furnish one (1) each Advance Tabco Model 7-PS-82/7-PS-16/7-PS-17, hand sink complete per manufacturer's specifications.

1. Provide side splashes

E15 Spare number

E16 Plate dollies **Four required** **KECF/KECI**

Furnish four (4) each Metro Model PCD11A/AD11A/PCDV11A, plate dolly complete per manufacturer's specifications.

E16A Dish carts **Three required** **KECF/KECI**

Furnish three (3) each Metro Model , dish cart complete per manufacturer's specifications.

E17 Glass rack dolly **Two required** **KECF/KECI**

Furnish Two (2) each Metro Model DH2020N, glass rack dolly complete per manufacturer's specifications.

Area "S" Numbers: S01 through S02

S01 Spare number

S02 Dry storage shelving **One lot required** **KECF/KECI**

Furnish one (1) lot of Metro super adjustable series shelving assemblies complete per manufacturer's specifications and the following.

1. Each assembly to be provided with (4) four, adjustable shelving units, and 74" posts.

WELLNESS KITCHEN

Area "B" Numbers: B01 through B12

B01 Undermount hand sink **One required** **KECF/KECI**

Furnish one (1) each Advance model 1014A-10A, undermount hand sink, complete per manufacturer's specifications.

B01A Faucet **One required** **KECF/KECI**

Furnish one (1) each T&S model B-0326, faucet, complete per manufacturer's specifications.

B02 Undercounter refrigerator **One required** **KECF/KECI**

Furnish one (1) each True Model TUC-27ADA-glass door, undercounter refrigerator, complete per manufacturer's specifications.

B03 Coffee brewer system **One required** **KECF/KECI**

Furnish one (1) each Top Brewer model Top Brewer, coffee brewer system, complete per manufacturer's specifications.

B03A CO2 tanks – NIKEC **One required** **VF/VI**

Furnish one (1) CO2 tanks, not in kitchen equipment supplier contract

B04 Dispenser **One required** **KECF/KECI**

Furnish one (1) each Crysalli model CBR-V3, dispenser, complete per manufacturer's specifications.

B05 Undercounter refrigerator **One required** **KECF/KECI**

Furnish one (1) each True Model TUC-27ADA, undercounter refrigerator, complete per manufacturer's specifications.

B06 Water appliance/faucet **One required** **KECF/KECI/GCI**

Furnish One (1) each Crysalli Model CR-UC2/CBR-V2 tower, water appliance/faucet, complete per manufacturer's specifications.

B06A CO2 tanks – NIKEC **One required** **VF/VI**

Furnish one (1) CO2 tanks, not in kitchen equipment supplier contract

B07 Ice & water dispenser **One required** **KECF/KECI/GCI**

Furnish One (1) each Follett Model 15CI100A-IW-NF-ST-OO, ice &water dispenser, complete per manufacturer's

specifications.

B08 Display Case One required KECF/KECI
Furnish one (1) each Structural Concepts model NE3655RSSV, display case, complete per manufacturer's specifications.

B09 Air Curtain Display Case Three required KECF/KECI
Furnish three (3) each Infrico model IAG-EML-9INOXM1, air curtain display case, complete per manufacturer's specifications.

B10 Spare number

B11 Spare number

B12 Undercounter freezer One required KECF/KECI
Furnish one (1) each True Model TUC-27F, undercounter freezer, complete per manufacturer's specifications.

Area "D" Numbers: D01 through D12

D01 Dishwasher/ventless One required KECF/ KECI/GCI
Furnish one (1) each Ecolab model ES-2000HT, ventless high temp. dishwasher, complete per manufacturer's standard specifications and the following:

1. Provide stainless steel enclosed top-mounted control panel.
1. Provide stainless steel pumps and impeller.
2. Provide common drain connection.
3. Unit to be wired for 280 volt 60hz, 3 phase operation.
4. Provide all required connections to and from dishtables.
5. Provide water pressure reducing valve and hammer arrestor.
6. Verify required formation and shape of connecting end with Hobart specifications. Provide all necessary attachments for mounting.
7. Provide factory authorized start-up and demonstration.

D02 Soiled landing w/ Mushroom Overshelf One required KECF/KECI/GCI
Provide one (1) each custom fabricated soiled dish landing w/rinse sink/rubber knock ring sized as shown in drawings and in Standard Details, sheet

1. Soiled landing to slope away from front landing 1/8" per foot.
2. Turn up all exterior edges in 3" turn up terminating in a 180° bullnose turn-down, except at walls.
3. Provide 14" splash at wall with 45° top angled back to wall and 1" turn down to wall and back to wall by 1" at exposed ends. .
4. Leg mount channels to be stud bolted to underside of top to accommodate s/s welded gusset plates. Legs to be 1 5/8" 16 ga s/s tubular type reinforced with fully welded cross-braces and with CHG Model AYE type or better heavy duty feet with 3" adjustment.
5. Ends to terminate at dishwasher. Verify all requirements for connection with dishwasher, item D04.
6. Mount wall side to wall with Z-clips.
7. Fabricator to provide shop drawings for approval by consultant.

D02A Spray rinse assembly One required KECF/KECI
Furnish one (1) each T&S, model B-0133-BC, spray rinse with faucet, complete per manufacturer's specifications.

D03 Clean landing One required KECF/ KECI
Furnish one (1) each custom fabricated stainless steel corner pot sink section with landings, sized as shown on drawings and in Standard Detail Sheet . Furnish as part of this item:

1. Landings and sinks to be 14ga s/s with rolled edge dishtable well.
2. Provide splash to 10" at wall with 45º top angled back to wall and 1" turn down to wall and back to wall by 1" at exposed ends.
3. Leg mount channels to be stud bolted to underside of sinks to accommodate s/s welded gusset plates.
4. Legs to be 1 5/8" 14 Ga. s/s tubular type with CHG Model AYE type or better heavy-duty feet with 3" adjustment.
5. Configuration per plan and elevations.
6. Provide 10" splash at wall with 45° top angled back to wall and 1" turn down to wall and back to wall by 1" at exposed ends.

D04 Poker Chip Dolly **One required** **KECF/KECI**

Furnish one (1) each Metro Model PCD11A/AD11A/PCDV11A, poker dolly complete per manufacturer's specifications.

D05 Glass rack dolly **One required** **KECF/KECI**

Furnish one (1) each Metro Model DH2020N, glass rack dolly complete per manufacturer's specifications.

D06 Barred wall shelves **Four required** **KECF/KECI**

Provide four (4) custom barred wall shelving sized and shaped as shown in drawings and the following and Standard Details sheet

1. Frame to consist of 16ga s/s 1" minimum box tubing supported by 12ga 14" deep by 10" tall brackets.
2. Shelf to consist of 1" OD 16ga tubular s/s bars sized and configured as shown in Standard
3. Brackets must mount to wall with welded flange with four anchoring holes. Contractor to provide anchoring bolts.
4. Contractor to verify mounting height.
5. Fabricator to provide shop drawings for approval by consultant

D07 Wall Shelf/Pot rack **One required** **KECF/KECI**

Furnish one (1) each Advance model PS-18-48, wall shelf, complete per manufacturer's specifications.

D08 Three compartment sink **One required** **KECF/KECI**

Furnish one (1) each Advance Tabco Model 94-83-60-36RL, three compartment sink, complete per manufacturer's specifications.

D08A Spray rinse assembly **One required** **KECF/KECI**

Furnish one (1) each T&S, model B-0133-BC, spray rinse with faucet, complete per manufacturer's specifications.

D08B Faucet **One required** **KECF/KECI**

Furnish one (1) each T&S, model B-0231, faucet, complete per manufacturer's specifications.

D09 Hand sink, wall mount, knee valve/side splashes **One required** **KECF/KECI/GCI**

Furnish one (1) each Advance Tabco Model 7-PS-82/7-PS-16/7-PS-17, hand sink complete per manufacturer's specifications.

1. Provide side splashes

D10 Spare number

D11 Spare number

D12 Spare number

Area "J" Numbers: J01 through J05

J01 Mop sink cabinet **One required** **KECF/KECI**

Furnish one (1) each Advance 9-OPC-84 (K-94, K-240), mop sink cabinet, complete per manufacturer's specifications.

J02 Chemical shelf **One lot required** **KECF/KECI**

Furnish one (1) each Metro 21x42, 4 tier, chemical shelf, complete per manufacturer's specifications.

J03 Trash bin **Six required** **KECF/KECI**

Furnish six (6) each, Rubbermaid FG9W2700YEL, trash bin, complete per manufacturer's specifications.

J04 Spare number

J05 Spare number

Area "K" Numbers: K01 through K27

K01 Ventilation Canopy with MUA plenum One required KECF/KECI /CGI

Furnish one (1) each Streivor Air TBD, listed ventilation canopy, complete per manufacturer's specifications with duct connection sizes, CFM, static pressure and electrical requirements as noted on plan. Unit to include the following: Final length of hood shall be verified with building "for construction" plans before release for fabrication.

1. Ventilator to be installed at 7'-0" above finished floor.
2. Ventilator to be UL approved hood.
3. Streivor to provide ceiling mounted make-up air plenum
4. Ventilator be pre-plumbed at the factory for Ansul connections.
5. Provide recessed fluorescent lights.
6. Unit to be wired 120/60 single phase.
7. Equipment contractor to provide all required 20 Ga. s/s filler panels and trim pieces to enclose to ceiling or soffit line above and to either side.
8. Provide shop drawings
9. Furnish one (1) each ventilation demand control system, complete per manufacturer's standard specifications. Coordinate installation with G.C.
10. See Streivor Air shop drawings for complete details.

K02 Ventilation Canopy with MUA plenum One required KECF/KECI /CGI

Furnish one (1) each Streivor Air TBD, listed ventilation canopy, complete per manufacturer's specifications with duct connection sizes, CFM, static pressure and electrical requirements as noted on plan. Unit to include the following: Final length of hood shall be verified with building "for construction" plans before release for fabrication.

1. Ventilator to be installed at 7'-0" above finished floor.
2. Ventilator to be UL approved hood.
3. Streivor to provide ceiling mounted make-up air plenum
4. Ventilator be pre-plumbed at the factory for Ansul connections.
5. Provide recessed fluorescent lights.
6. Unit to be wired 120/60 single phase.
7. Equipment contractor to provide all required 20 Ga. s/s filler panels and trim pieces to enclose to ceiling or soffit line above and to either side.
8. Provide shop drawings
9. Furnish one (1) each ventilation demand control system, complete per manufacturer's standard specifications. Coordinate installation with G.C.
10. See Streivor Air shop drawings for complete details.

K03 Hood Fire System One required KECF/KECI /CGI

Furnish one (1) lot system(s) Pyrochem Kitchen Knight wet chemical system to provide surface, plenum, and duct protection for all items of cooking equipment located under the hoods in accordance with all applicable codes, ordinances, regulations and provisions of NFPA 17 and 96.

1. All systems shall be pre-piped into the hoods by the manufacturer and all system piping, fittings and conduits shall be concealed where possible and all drops shall be vertical with chrome plated finish and no exposed threads and no angled drops.
2. System to be interwired with shunt trip breakers and gas line solenoid cutoff valves serving items of cooking equipment beneath the hoods to provide power and gas shut off in the event of system engagement.

3. Kitchen equipment contractor to provide sufficient number of adequately sized gas line solenoid valves to the plumbing contractor for installation in the gas line.
4. Electrical contractor to provide and install shunt trip breaker if required.
5. Provide remote pull fire stations as required for system located per local code and coordinated with consultant and architect.
6. Interwire system to fan controls of ventilators and supply fans and to building life-safety system per local codes and ordinances.
7. All field inspections, testing, and certification to be performed by factory authorized Ansul agency as part of this contract.
8. Provide as part of submittal package fire suppression shop drawings.
9. See Streivor Air Sheet DA-00 shop drawings for complete details.

K04 Stainless steel wall lining — One lot required — KECF/KECI

Furnish one (1) lot of 20 ga stainless steel sheets set in a full bed of heat resistant mastic. Furnish in quantity sufficient for rear and side wall areas below all hoods as shown in drawings. Liner to extend from floor curb to one inch above bottom of ventilator. All joints between panels, coved flooring tiles and ventilators either horizontal or vertical to be sealed with s/s "S" channels full length and capped or terminated in burr-free mitered corners.

K05 Vertical Rotisserie — One required — KECF/ KECI/GCI

Furnish one(1) each Woodstone, model WS-GVR-10, vertical rotisserie, complete per manufacturer's specifications.

K06 Fryer — One required — KECF/ KECI/GCI

Furnish one(1) each Montague, model RF40, fryer, complete per manufacturer's specifications and the following:

1. Provide locking casters
2. Provide 48" gas quick disconnect

K07 Griddle — One required — KECF/ KECI/GCI

Furnish one(1) each Montague, model DG2448-SAT, griddle complete per manufacturer's specifications and the following:

1. Provide 48" gas quick disconnect

K08 Chefs refrigerated base — One required — KECF/ KECI/GCI

Furnish one(1) each Infrico model IUC-MSG48, chefs refrigerated base, complete per manufacturer's specifications.

K09 Range with oven — One required — KECF/ KECI/GCI

Furnish one(1) each Montague, model 136-5, range with oven, complete per manufacturer's specifications and the following:

1. Provide locking casters
2. Provide 48" gas quick disconnect

K10 Spare number

K11 Spare number

K12 Spare number

K13 Barred wall shelves — Two required — KECF/KECI

Provide two (2) custom barred wall shelving sized and shaped as shown in drawings and the following and Standard Details sheet

1. Frame to consist of 16ga s/s 1" minimum box tubing supported by 12ga 14" deep by 10" tall brackets.
2. Shelf to consist of 1" OD 16ga tubular s/s bars sized and configured as shown in Standard
3. Brackets must mount to wall with welded flange with four anchoring holes. Contractor to provide anchoring bolts.
4. Contractor to verify mounting height.
5. Fabricator to provide shop drawings for approval by consultant

K14 Tilt braising pan with stand/faucet — One required — KECF/ KECI/GCI

Furnish one (1) each Cleveland Model SET-10, tilt brasing pan complete per manufacturer's specifications and the

following:

1. Provide stand
2. Provide double pantry faucet
3. Provide gallon markings

K14A Floor Trough One required KECF/KECI

Provide one (1) each custom fabricated floor trough sized as shown in drawings and in Standard Details,sheet.

1. Fabricator to provide shop drawings for approval by consultant.

K15 Broiler One required KECF/ KECI/GCI

Furnish one(1) each Montague, model UFS-30C, broiler complete per manufacturer's specifications and the following:

1. Provide 48" gas quick disconnect

K16 Combi-oven One required KECF/ KECI/GCI

Furnish one (1) each Rational model SCCWE61 & SCCWE101 combi-ovens, complete per manufacturer's standard specifications and the following:

1. Unit to be configured for electric operation and shall be field calibrated by factory authorized personnel upon installation.
2. Provide full compliment of available accessories.

K17 Speed racks Three required KECF/ KECI/GCI

Furnish three (3) each Metro Model RD3N, complete per manufacturer's specifications.

K18 Island prep table with prep sink/overshelves One required KECF/KECI/GCI

Furnish one (1) each custom fabricated worktable sized as shown in drawings per standard details sheet and the following:

1. Reinforce full length of top with inverted hat channel.
2. Provide 14ga construction.
3. Legs to be 1 5/8" 16 Ga. s/s tubular type with fully welded with CHG Model AYE type or better
4. Provode 20"x20"x14" deep prep sink
5. Provide overshelf, size as per drawings
6. Provide out let boxes (2ea.)
7. Provide stainless steel cutting board slides
8. Fabricator to provide shop drawings for approval by consultant.

K18A Faucet One required KECF/KECI

Furnish one (1) each T&S, model B-0221-CC, faucet, complete per manufacturer's specifications.

K19 Island prep table with prep sink/overshelves One required KECF/KECI/GCI

Furnish one (1) each custom fabricated worktable sized as shown in drawings per standard details sheet and the following:

1. Reinforce full length of top with inverted hat channel.
2. Provide 14ga construction.
3. Legs to be 1 5/8" 16 Ga. s/s tubular type with fully welded with CHG Model AYE type or better
4. Provode 20"x20"x14" deep prep sink
5. Provide overshelf, size as per drawings
6. Provide out let boxes (2ea.)
7. Provide stainless steel cutting board slides
8. Fabricator to provide shop drawings for approval by consultant.

K20 Spare number

K21 Spare number

K22 Spare number

K23 Undercounter refrigerator One required KECF/ KECI/GCI

Furnish one(1) each Infrico IUC-UC60R, undercounter refrigerator, complete per manufacturer's specifications.

K24 Prep table with handsink/prep sink/overshelves One required KECF/KECI/GCI

Furnish one (1) each custom fabricated worktable sized as shown in drawings per standard details sheet and the following:

1. Reinforce full length of top with inverted hat channel.
2. Provide 14ga construction.
3. Legs to be 1 5/8" 16 Ga. s/s tubular type with fully welded with CHG Model AYE type or better
4. Provide 20”x20”x14” deep prep sink
5. Provide 10”x14”x10” deep handsink
6. Provide overshelf, size as per drawings
7. Provide 6” splash at wall
8. Provide stainless steel cutting board slides
9. Fabricator to provide shop drawings for approval by consultant.

K24A Faucet One required KECF/KECI

Furnish one (1) each T&S, model B-0326, faucet, complete per manufacturer’s specifications.

K24B Faucet One required KECF/KECI

Furnish one (1) each T&S, model B-0221-CC, faucet, complete per manufacturer’s specifications.

K25 Wall shelves Two required KECF/KECI

Furnish Two (2) custom fabricated wall shelves sized as shown in drawings and per Standard Detail

1. Fabricator to provide shop drawings for approval by consultant.

K26 Ice Machine One required KECF/ KECI/GCI

Furnish one (1) each Manitowoc, model IY-0854A/B-570, air cooled ice machine with bin, half diced ice complete per manufacturer’s specifications and the following:

1. Unit to be wired for 208/60 single phase operation.
2. Provide pressure reducing valves if required.
3. Provide all stacking kits, supports, and cutout kits for proper and complete installation.

K27 Remote – Walk-in Cooler One lot required KECF/KECI/GCI

Furnish one (1) each Thermalrite, walk-in cooler/freezer cold storage room(s) assembly per plans and detail drawings, with all labor, material, equipment, and tools required for the complete installation of modular foamed panel pre-fabricated cold storage rooms of size and shape as shown on plan and specified herein. Exterior height shall be 7’-4”. Carefully check dimensions of areas and notify Muller Design Associates of any discrepancies prior to fabrication of unit.

This walk in cooler/freezer has now straight walls and do not notch out around building support beams.

Installation to be provided by the manufacturer.

WORK INCLUDED

Wall, corner, floor and ceiling panels, door assemblies, light switches and light fixtures, digital thermometer/alarm, utility penetrations, escutcheon plates, drain line bumper, finish trim, interior floor insulation, and interior wall protection.

MATERIALS

a. Insulation: Insulation to be 4 inch thick foamed in place polyurethane foam.
   Insulation to be Class I with flame spread rating not to exceed 25. Thermal conductivity (K-factor) not to exceed 0.14/BTU/hr/sq./ft/F.
b. Urethane Foam Insulation: Rigid HCFC filled, over 90 percent closed cell content, nominal density of 2.2 pounds per cubic foot +O.l CF -0.
c. Dimensional Stability - No change from -20 degrees F to +160 degrees F.
d. Sheet aluminum - ASTM B209, Alloy 5052 H34.
e. Stainless steel sheet ASTM A167, Type 304, No. 4 finish.
f. Galvanized steel sheet ASTM A525, G90.
g. Silicone sealant - FDA approved sealant; GE 1200 or other approved.

h. Foil laminated Kraft paper - 0.01 perm per ASTM E96, Fortifier "Poly Foil Barrier", or other approved.
i. PVC Membrane - 0.01 perm per ASTM E96 or less.
j. Asphalt emulsion - ASTM D1187 clay type
k. Interior shall be white embossed aluminum.

FABRICATION AND MANUFACTURER

Panel fabrications: Wall and ceiling panels shall be modular sandwich panel designed with stressed sheet metal facing and 4" thick foamed in place urethane insulation. Lateral alignment of adjoining panels shall be provided by continuous spline and groove of panel edges. Panels shall be rigidly coupled by cam action locks, maximum 4'-0", on-center. Section lock port openings shall be finished with snap-in buttons. Maximum deflection of ceiling panels shall not exceed 1/240th of tile span under a load of 20 pounds per square foot.
Panel Fascia: Interior face of ceiling panels shall be clad with .032 stucco embossed aluminum white baked enamel. Interior face of wall panels shall be clad with .032 stucco embossed aluminum white baked enamel.

Roof panel spans exceeding 12'0" shall be additionally supported by overhead suspension system, consisting of beam clamps, hanger rods, angles, fasteners and panel connectors as furnished by manufacturer. Provide detailed drawings indicating method of support.

Insulated Floor (Coolers/Freezer): Subfloor membrane shall consist of asphalt emulsion applied to clean smooth concrete subfloor. Cover with foil coated Kraft waterproof paper, Fortifiber "Polyfoil Barrier" or equal (0.01 Perm as determined by ASTM - E96-80) extending under wall panels. Joints shall be overlapped a minimum of 6".

Cooler/Freezer floors shall be insulated with foam board urethane insulation. Joints shall be staggered or splined. Floor insulation shall be installed after the erection of wall panels or as an integral part of wall panel installation.

Total thickness of cooler/freezer floor insulation shall be 4" thick, Vapor permeable separation of organic 15 pound felt protective slip sheet for applying over insulation with joints overlapped a minimum of 6" and flashed up height of base.

Floor Insulation: After erection of wall panels, cooler/freezers shall be insulated with 4 inches of rigid, urethane boardform foam of same density and conductivity as panel insulation. Joints shall be staggered.

Provide insulated diamond tread floor in freezer with interior ramp

Vapor Permeable Separation: 15 pound felt, protective slip sheet shall be applied over insulation, flashed up height of cove and joints lapped 6 inches minimum.

General contractor shall be recalled to fill in concrete and 1” square 20 ga zinc coated steel wire cloth to completely fill depression, in compliance with NSF revision March 1997.

Interior finish floor and cove shall be continuous and level throughout refrigerated and freezer compartments and is included in this contract.

FLOOR

Provide diamond tread plate insulated floor with interior ramp.

REFRIGERATOR AND FREEZER DOORS (DEADBOLT)

Door width in clear (WIC) and height in clear (HIC) opening size shall be 3' wide by 7' high, or sized as shown on drawing.

Door shall be insulated with 3 inches thick core of same insulating material specified for wall panels. The ambient side of freezer door perimeter and door jamb, including threshold, shall be provided with 120 volt, 500 watt heating element, including thermostat control, factory wired to "GS" splice box, located above door at interior face of wall panel.

Front, back and edges of doors shall be clad with 20 gauge stainless steel. Sheet metal joints of doors and door frames shall be heliarc welded, ground smooth and polished.

Door casing shall be raised 3/4 inch and 4 inches wide, at sides and head, clad with 18 gauge sheet metal , matching door face.

The ambient side of cooler and freezer doors perimeter and frame, including threshold shall each be provided with dual 120 volt , 240 watt each, electric resistance heating elements, including thermostatic controls, factory wired to "GS" splice box located above door at interior face of wall panel.

The threshold shall be removable 1/8" thick stainless steel plate.

Provide 15 inch by 20 inch, tempered hermetically sealed triple pane glass vision panel in prefabricated refrigerator and freezer door. Cooler and freezer door vision panel shall be furnished with electrically conducting, transparent tin coating on interior face of ambient pane connected to main door circuit.

Each door shall have interior/exterior kickplates of 3/16" aluminum treadplate and shall be 3 feet high and full width of door.

Three hinges, each door, shall be nylon cam stainless steel pin, zinc die cast, polished chrome finish.

Lock shall be mortise deadlock, including inside release, with bronze or stainless steel components. Exposed surfaces chrome plated. Cylinders shall be keyed differently and master keyed.

Door pull shall be high pressure die cast zinc highly polished chrome plated.

Norton 7500 hydraulic rack and pinion door closer shall have automatic hold open. Finish shall be three coat aluminum with lacquer final coat.

Gasket shall be extruded polyvinyl chloride with corners vulcanized and continuous magnetic core at side and head of door jamb.

Sill wiper shall be extruded neoprene secured by removable stainless steel retainer strip and stainless steel fasteners.

Hardware shall be mounted with reinforced steel tapping plates and stainless steel security machine screws.

Interior door cart bumper bar shall be 1/4" X 2" aluminum bar, 3'0" A.F.F.

Interior door jamb guards of 3/16" aluminum tread plate 48" high.

All door openings to ambient temperature to have a stainless steel locking bar with provision for padlock by others.

Provide (3) three sets of Anthony, or Equal, 48”wide x 54” high double side by side swinging reach-in glass door assemblies. Position in wall panel assembly per plans. Bottom of door to be mounted 34” AFF. Provide with hinges and lock assembly.

LIGHT FIXTURES AND SWITCHES

Quantity of light fixture shall be as indicated on the Food Service Equipment Electrical Plan.

Fixtures shall be Luminaire incandescent light fixture #LVP1212, or equal, cast aluminum, fully enclosed and gasket for vaportight, weathertight operation, with shatterproof diffuser and furnished with two 100-watt lamps and one 10-watt lamp.

Provide vapor tight cast junction box and galvanized steel nipple of proper length to terminate at exterior of roof panel.

Factory install and wire interior and exterior companion 3-way and/or 4-way AC press-switches, where indicated, mounted in "FS" boxes adjacent to latch side of door openings.

Switch covers shall be neoprene, weatherproof press-switch plates or equal.

Provide pilot light with unbreakable red plastic lens embedded in neoprene plate:

1. Interior red light - constant burning
2. Exterior red light - indicating

Rigid zinc coated steel conduit and wiring shall be run within insulated wall panel. Conduit shall be terminated in vapor tight splice box mounted on inside wall of compartment near ceiling.

NOTE: only conduit and wiring within wall panel, including boxes, light fixture, switches and cover plates, shall be furnished as part of this contract.

DIGITAL THERMOMETER AND ALARM
Thermometer and alarm shall consist of computer, silence button, trouble light, digital read out and stainless steel cover. The thermometer shall be flush-mounted with stainless steel cover plate, mounted adjacent to the door pre-wired with rigid conduit and wiring run within the wall panel using 'FS' recessed box on the exterior and terminated in a "GS" splice box mounted on the interior near the ceiling. Provide a 1 1/4" hole in the ceiling panel with loose escutcheon through which the General Contractor shall make the final connection.

Panel mount digital thermometer shall be provided for each unit. System shall be manufactured by Modularm Model 75. Furnish with sensor bulb mounted in the return air stream.

PRESSURE RELIEF VENT
Factory mount in head section, electrically heated vacuum pressure relief vent above each freezer door.

COIL SUPPORTS
Furnish to the mechanical refrigeration contractor sufficient quantity of 1/2 inch diameter nylon threaded rods with stainless steel nuts and washers to accommodate support of refrigeration coils.

UTILITY PENETRATIONS
Each trade to provide penetrations at refrigerator and freezer wall and ceiling panels to accommodate electrical, refrigeration lines and drain lines.

ESCUTCHEON PLATES
Furnish sufficient quantity of 5 inch diameter stainless steel escutcheon plates for each trade to dress off utility penetrations. Each trade shall be responsible for cutting hole in blanks and sealing of respective penetrations.

FINISH TRIM
Tolerance gaps between face of cold room walls and building walls shall be finished with matching sheet metal angles furnished and installed by the Contractor.

CLOSURE PANELS
Space between suspended ceiling and top of refrigerator shall be enclosed with matching sheet metal panels designed for easy removal to facilitate access to crawl space (dimensions permitting) as furnished by the Refrigerator Contractor.

CORNERGUARDS
Provide 4" X 4" - 1/8" gauge stainless steel 4'0" high corner guards at each exposed corner with mechanical fasteners and two faced adhesive tape.

WAINSCOT OF ALUMINUM TREADPLATE
Provide 48" high, 3/16" thick aluminum treadplate, wainscot to all exposed exterior and with Henry's #117 panel adhesive and mechanically fastened with stainless steel truss head phillips #8 X 3/4" screws 24" centers top and bottom..

Inspect each aluminum tread plate panel for sharp edges or burrs. Remove or file off any or all protuberances.

K27A Coil One required KECF/KECI/GCI
Furnish one(1) each Coldzone, AA38-1608, ceiling low profile coils, complete per manufacturer’s specifications.

K27B Condenser rack One required KECF/KECI/GCI
Furnish one(1) each Coldzone, Uni Pak, condenser rack, complete per manufacturer’s specifications.

K28 Spare number

K29 Spare number

K30 Water filter One required KECF/KECI/GCI

Furnish one (1) each Everpure model High Flow EV943730, water filter system complete manufacturer's standard specifications and the following:

4. Mount unit as shown on drawings.
5. Provide all required mounting and connection parts.
6. Provide as part of this item, two replacement filters for each filter supplied as part of model number.

Storage "S" Numbers: S01 through S03

S01 Lockers/employee One lot required KECF/KECI

Furnish one (1) lot each KelMax model EL/6 lockers/employee in complete per manufacturer's specifications and the following:

1. Exterior finish gray

S02 Dry storage shelving One lot required KECF/KECI

Furnish one (1) lot of Metro super adjustable series shelving assemblies complete per manufacturer's specifications and the following.

1. Each assembly to be provided with (4) four, adjustable shelving units, and 74" posts.

S03 Dry storage shelving One lot required KECF/KECI

Furnish one (1) lot of Metro super adjustable series shelving assemblies complete per manufacturer's specifications and the following.

1. Each assembly to be provided with (4) four, adjustable shelving units, and 74" posts.

END OF SECTION 114000

SECTION 115300 – LABORATORY EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Ice Machine, Undercounter

1.2 RELATED SECTIONS

A. Division 22: Furnishing and installation of plumbing utilities and final connections to service fittings.

B. Division 23: Furnishing and installation of exhaust ductwork and equipment, and final connection to exhaust devices.

C. Division 26: Furnishing and installation of electrical utilities and final connections to casework and accessory equipment.

1.3 DELEGATED ENGINEERING REQUIREMENTS

A. Contract Documents Design Intent: Drawings and Specifications indicate design intent for products and systems and do not necessarily indicate or specify total Work required and shall not be construed as an engineered design. Furnish and install all Work required for a complete installation.

B. Delegated Engineering Responsibility: Contractor shall employ a qualified professional engineer to provide engineering for products and systems including attachment to building structure required to meet design intent of Contract Documents including, but not limited to, the following.

1. Preparation of structural analysis data including engineering calculations, shop drawings and other submittals signed and sealed by the qualified professional engineer responsible for their preparation.

C. Coordination of Contract Documents and Work:

1. Product Variations: In the event of minor differences between products and systems of acceptable or available manufacturer/fabricators, Contractor shall notify Architect of such differences and resolve conflicts in a timely manner. Failure of Contractor to provide notification shall be construed as acceptance of conditions indicated, and changes caused by minor differences between products and Contract Documents shall be included in the Work at no additional cost to Owner.
2. Allowable Adjustments: Minor dimension and profile adjustments may be made in interest of fabrication or erection methods or techniques or ability to satisfy design intent, provided design intent is maintained as determined by Architect. Proposed deviations shall include a detailed analysis of impact to adjacent substrates or other building systems, including related design or construction cost impacts. If accepted by Architect, deviations causing changes in materials, constructability, substrates, or conditions shall be included in the Work at no additional cost to Owner.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's data for each component and item of laboratory equipment specified. Include component dimensions, configurations, construction details, joint details, and attachments. Indicate location, size and service requirements for each utility connection.

B. Manufacturer's operating and maintenance manuals.

C. Warranty: Sample of warranty.

1. Provide manufacturer's written warranty covering materials and installation (labor) stating obligations, remedies, limitations and exclusions.

1.5 QUALITY ASSURANCE

A. Manufacturer shall have at least 5 years experience in the fabrication of the specified equipment and shall have 10 installations of equal or larger size.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Schedule delivery of equipment so that spaces are sufficiently complete that material can be installed immediately following delivery.

B. Handling: Protect finished surfaces from soiling or damage during handling and installation. Keep covered with polyethylene film or other protective coating.

1.7 PROJECT CONDITIONS

A. Do not deliver or install equipment until the following conditions have been met:

1. Windows and doors are installed and the building is secure and weathertight.
2. Ceiling, overhead ductwork, and lighting are installed.
3. All painting is completed and floor tile is installed.

B. Field Measurements: Where products and systems are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.8 WARRANTY

A. Manufacturer's Warranty: Furnish manufacturer's written material and labor warranty signed by an authorized representative using manufacturer's standard form agreeing to furnish materials and labor required to repair or replace work which exhibits material defects caused by manufacture or design and installation of product. "Defects" is defined to include but not limited to deterioration or failure to perform as required.

1. Coverage of warranty includes but is not limited to the following:

2. Warranty Period: Manufacturer shall warrant the products to be free from material and labor Defects for a period of 1 year from date of Substantial Completion

B. Installer's Warranty: Furnish installer's written workmanship warranty signed by an authorized representative using installer's standard form agreeing to provide labor required to repair or replace work which exhibits workmanship defects. "Defects" is defined to include but not limited to deterioration or failure to perform as required.

1. Warranty Period: Installer shall warrant the installation to be free from workmanship Defects for a period of 1 year from date of Substantial Completion.

C. Factory Applied Finish Warranty: Furnish manufacturer's written warranty signed by an authorized representative using manufacturer's standard form agreeing to repair finish or replace work which exhibits finish defects. "Defects" is defined to include but not limited to deterioration or failure of finish to perform as required.

1. Coverage includes but is not limited to the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: Manufacturer shall warrant the installation to be free from finish defects for a period of 1 year from date of Substantial Completion.

D. If exploratory work is required to determine the cause of the defects, the cost of such work shall be borne by the Contractor if the work is found to be defective as judged by the Architect.

1.9 COORDINATION

A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

A. Acceptable Manufacturers/Fabricators and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers/fabricators listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section "Substitution Procedures".

2.2 ICE MACHINE, UNDERCOUNTER

A. Acceptable. Manufacturers:

1. Hoshizaki Europe B.V. (Model F-330BAH)
2. Scotsman Ice Systems (Model AFE424A-1 with KLP8S)
3. Manitowoc Ice (Model RF-0385A)

B. Size: 34 inches high with legs, by 24 inches wide, by 24 inches deep.

C. Capacity: Ice making capacity of up to 400 pounds in 24 hours with a bin capacity of 80 pounds.

D. Refrigeration System: 1/5 horsepower compressor with air cooled condenser.

E. Electrical: 120/60/1, 6.1 amp. Provide with grounded cord and plug.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION, GENERAL

A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:

1. Respective manufacturer/fabricator's written installation instructions.
2. Accepted submittals.
3. Contract Documents.

B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.

3.3 PREPARATION

A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

3.4 INSTALLATION

A. Miscellaneous laboratory equipment shall be installed in strict accordance with the manufacturer's recommendations, including recommended operating and servicing clearances.

B. Plumbing hookups under Division 22.

C. Mechanical hookups under Division 23.

D. Electrical hookups under Division 26.

E. Check project for conditions that affect work. Do not begin installation until unsatisfactory conditions are corrected.

3.5 ADJUSTING

A. Repair or remove and replace defective work as directed by Owner's Representative upon completion of installation.

B. Adjust moving or operating parts to function smoothly.

3.6 CLEANING AND PROTECTION

A. Clean shop finished equipment, touch up as required, and remove and refinish damaged or soiled areas.

B. Cover equipment for protection against soiling and deterioration during remainder of construction period.

C. Equipment shall be protected before, during and after installation. Damaged materials due to improper protection shall be cause for rejection.

END OF SECTION 115300

SECTION 115313 - LABORATORY FUME HOODS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Benchtop Laboratory Fume Hoods
2. Fume Hood Base and Special Cabinets

B. Related Sections:

1. Division 12: Laboratory Casework and Furnishings.
2. Division 22: Furnishing and installation of plumbing utilities and final connections to fume hoods.
3. Division 23: Furnishing and installation of exhaust duct work and equipment, and final connection of fume hoods.
4. Division 23: Furnishing and installation of exhaust controls and final connections to hoods.
5. Division 26: Furnishing and installation of electrical utilities and final connections to fume hoods.

1.2 DESIGN REQUIREMENTS

A. Factory UL 1805 Classified.

B. Fume hoods shall function as ventilated, enclosed work spaces, designed to capture and confine exhaust fumes, vapors and particulate matter produced or generated within the enclosure.

C. Design fume hoods for consistent and safe air flow through the hood face. Negative variations of face velocity shall not exceed 10 percent of the average face velocity at any designated measuring point as defined in this section.

D. Average illumination of work area: Minimum 80 footcandles. Work area shall be defined as the area inside the superstructure from side to side and from face of baffle to the inside face of the sash, and from the working surface to a height of 28 inches.

E. Maximum average static pressure loss readings taken three diameters above the hood outlet from four points, 90 degrees apart not to exceed:

Face Velocity	Measured Static Pressure Loss (W.G.)
75 FPM	0.18 inches
100 FPM	0.30 inches
125 FPM	0.45 inches
150 FPM	0.60 inches

F. Fume hoods shall be constructed in such a manner as to cause no perceptible increase in sound pressure level over the mechanical exhaust system.

G. Fume hood to have set baffle system. No adjustable baffles allowed.

1.3 DELEGATED ENGINEERING REQUIREMENTS

A. Contract Documents Design Intent: Drawings and Specifications indicate design intent for products and systems and do not necessarily indicate or specify total Work required and shall not be construed as an engineered design. Furnish and install all Work required for a complete installation.

B. Delegated Engineering Responsibility: Contractor shall employ a qualified professional engineer to provide engineering for products and systems including attachment to building structure required to meet design intent of Contract Documents including, but not limited to, the following.

1. Preparation of structural analysis data including engineering calculations, shop drawings and other submittals signed and sealed by the qualified professional engineer responsible for their preparation.

C. Coordination of Contract Documents and Work:

1. Product Variations: In the event of minor differences between products and systems of acceptable or available manufacturer/fabricators, Contractor shall notify Architect of such differences and resolve conflicts in a timely manner. Failure of Contractor to provide notification shall be construed as acceptance of conditions indicated, and changes caused by minor differences between products and Contract Documents shall be included in the Work at no additional cost to Owner.
2. Allowable Adjustments: Minor dimension and profile adjustments may be made in interest of fabrication or erection methods or techniques or ability to satisfy design intent, provided design intent is maintained as determined by Architect. Proposed deviations shall include a detailed analysis of impact to adjacent substrates or other building systems, including related design or construction cost impacts. If accepted by Architect, deviations causing changes in materials, constructability, substrates, or conditions shall be included in the Work at no additional cost to Owner.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's data for each type of hood specified. Include component dimensions, configurations, construction details, joint details, and attachments. Indicate location, size, and service requirement for each utility connection.

B. Shop Drawings:

1. Submit shop and fabrication drawings stamped by a licensed California Professional Engineer for the laboratory Fume Hoods. This engineer shall perform and submit structural calculations to document the Fume Hoods and proper anchorage to building components.
2. Provide 3/8 inch = 1'-0" scale minimum elevations of individual and battery of hoods showing cross sections, rough-in and anchor placements, tolerances, and clearances. Indicate relation to other laboratory equipment, surrounding walls, windows, doors, and other building components.
3. Provide 1/8 inch = 1'-0" scale minimum rough-in plan drawings for coordination with trades.

C. Top Samples: Submit product sample of each type of benchtop.

D. Finish Samples: Submit 3 inch by 5 inch samples of color of finish for fume hoods, work surfaces and for other prefinished equipment and accessories for selection by the Owner's Representative.

E. Certifications: All manufacturers to test and certify their products to meet UL1805, ASHRAE 110 and SEFA 1.

F. Field Quality Control Reports: Written report of testing and inspection required by “Field Quality Control”.

G. Manufacturer’s Project Acceptance Document: Certification by the manufacturer that its product(s) are approved, acceptable, suitable for use in specific locations, for specific details, and for applications indicated, specified, or required, and that a warranty will be issued.

H. Life Cycle Tests: Provide independent test data for sash hardware components such as chain and sprockets.

I. Maintenance Manuals: Provide written instruction manuals outlining operating and safety instructions and proper maintenance procedures.

J. Qualification Data: For manufacturer/fabricator, installer and professional engineer.

1. For firms and persons specified in "Quality Assurance" to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of Architects and Owners, and other information specified.
2. Architect may waive submittal of qualification data for available manufacturers listed in this Section.

K. Warranty: Sample of warranty.

1. Provide manufacturer’s written warranty covering materials and installation (labor) stating obligations, remedies, limitations and exclusions.

1.5 QUALITY ASSURANCE

A. Single Source Responsibility: Fume hoods, casework, work surfaces, laboratory furnishings, and accessories shall be furnished by a single laboratory furniture company.

B. Manufacturer's Qualifications: Modern plant with proper tools, dies, fixtures, and skilled production staff to produce high quality laboratory casework and equipment, and shall meet the following minimum requirements:

1. Ten years or more experience in manufacture of laboratory casework and equipment of type specified.
2. Ten installations of equal or larger size and requirements.

C. Installer's Qualifications: Factory trained and certified by the manufacturer.

1.6 PROJECT CONDITIONS

A. Field Measurements: Where products and systems are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

B. Do not deliver or install equipment until the following conditions have been met:

1. Building areas requiring the installation of laboratory casework shall be dry and unexposed to adverse weather conditions which may damage finished materials.
2. Interior building temperatures shall not register below 65 degrees Fahrenheit in areas of casework installation to permit the proper curing of epoxy sealants and adhesive.

1.7 COORDINATION

A. Coordinate installation of products and systems with interfacing and adjoining construction to provide a successful installation without failure.

1.8 SEQUENCING AND SCHEDULING

A. All overhead mechanical, electrical and plumbing rough-in work shall be complete prior to laboratory casework deliveries.

B. All mechanical, electrical and plumbing rough-in work required along walls and service islands, where lab furnishings are to be installed, is to be complete prior to delivery of materials.

C. Walls and partitions must be in place and finished with at least the primer coat of paint. If finish painting is to take place after lab furnishing installation, protect the casework and furnishings by covering and masking prior to commencement.

D. All necessary wood or metal blocking must be installed within partitions prior to delivery of casework and furnishings.

E. Overhead soffits and ceiling grid must be in place prior to casework installation.

F. Overhead lighting must be installed and connected prior to casework installation.

G. All flooring required to be placed under lab casework and furnishings must be installed prior to material delivery.

H. Concrete floors must be level within 1/8 inch of level per 10 foot run, nonaccumulative, when tested with a straight edge in any one direction.

I. Wet operations to be performed must be complete prior to material deliveries.

1.9 WARRANTY

A. Manufacturer's Warranty: Furnish manufacturer's written material and labor warranty signed by an authorized representative using manufacturer's standard form agreeing to furnish materials and labor required to repair or replace work which exhibits material defects caused by manufacture or design and installation of product. "Defects" is defined to include but not limited to deterioration or failure to perform as required.

1. Coverage of warranty includes but is not limited to the following:

2. Warranty Period: Manufacturer shall warrant the products to be free from material and labor Defects for a period of 1 year from date of Substantial Completion

B. Installer's Warranty: Furnish installer's written workmanship warranty signed by an authorized representative using installer's standard form agreeing to provide labor required to repair or replace work which exhibits workmanship defects. "Defects" is defined to include but not limited to deterioration or failure to perform as required.

1. Warranty Period: Installer shall warrant the installation to be free from workmanship Defects for a period of 1 year from date of Substantial Completion.

C. If exploratory work is required to determine the cause of the defects, the cost of such work shall be borne by the Contractor if the work is found to be defective as judged by the Architect.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

A. Available Manufacturers/Fabricators and Products: Subject to compliance with requirements of Contract Documents as judged by the Architect, manufacturers/fabricators offering products that may be incorporated into the Work include, but are not limited to, those listed.

1. Kewaunee Scientific Corporation, Laboratory Division
2. Labconco Corporation
3. Mott Manufacturing Limited.
4. Air Master Systems Corporation
5. Jamestown Metal Products Inc.

B. Basis of Design (Product Standard): Contract Documents are based on products and systems specified to establish a standard of quality. Other manufacturers/fabricators offering products having equivalent characteristics may be considered, provided deviations are minor and comply with requirements of Contract Documents as judged by the Architect.

C. Casework, furnishings and equipment specified in the following sections shall be furnished and installed by the same supplier.

1. Section: Laboratory Casework and Furnishings.

2.2 MATERIALS

A. Sheet Steel:

1. Metallic Furniture Stock: ASTM A-1008 mild steel, cold rolled, pickled, double annealed, and free from rust, scales, scratches, buckles, ragged edges, and other defects.
2. Minimum Gages:

a. All gages indicated shall be US Standard.
b. 18 gage thick exterior casing, ceiling closure panels, and bottom sash rail.

B. Stainless Steel:

1. Type 304: ASTM A240; 16 gage; exposed surfaces ground and polished to a Number 4 finish.
2. Type 316: ASTM A240; 16 gage; exposed surfaces ground and polished to a Number 4 finish.
3. Welding: All stainless steel welding material shall be of type similar to sheet material. Welds shall be made without discoloration; ground, polished, and passivated to blend harmoniously with a Number 4 satin finish.

C. Epoxy Resin Sheets:

1. Molded from modified epoxy resin that has been especially compounded and cured to provide optimum physical and chemical resistance required of a heavy duty laboratory working surface. Uniform mixture throughout, not dependent on a surface coating.

2. Physical Properties:

a. Compressive Strength (ASTM D695): 30,600 psi.
b. Flexural Strength (ASTM D790): 12,800 psi.
c. Tensile Strength (ASTM D638): 10,100 psi.
d. Heat Distortion (ASTM D648): 330 degrees Fahrenheit.
e. Water Absorption (ASTM D570): 0.018 percent.
f. Fire Resistance (ASTM D635): Self Extinguishing.

D. Glass: 7/32 inch clear laminated safety glass.

2.3 BENCHTOP CHEMICAL FUME HOODS

A. Factory UL 1805 Classified. Provide each fume hood with UL 1805 Classified labeling.

B. Superstructure:

1. Wall: Rigid, self supporting assembly of double wall construction, nominal 5 inches thick. Double wall shall consist of a sheet steel outer shell and a corrosion resistant inner liner and shall house and conceal steel framing members, attaching brackets and remote operating service fixture mechanisms and services. Hoods shall be completely factory assembled to form a rigid, self-supporting structure.
2. Face Opening Perimeter Edge: Air foil or streamlined shape with all right angle corners radiused or angled.
3. Interior Hood Height: 60 inches minimum to hood roof.

4. Exterior Bypass: Low resistant down draft type. Bypass air shall enter at horizontal full length opening at the top front superstructure to enter hood in a down flow direction. Directional louvers are not acceptable.
5. Interior Bypass:

    a. Restricted Bypass: Provide an interior bypass plate with 1 inch minimum continuous slot at sash header on all variable volume or constant volume hoods with combination sashes and on all variable volume hoods with a vertical rising sash.
    b. Interior bypass plate: Manufactures standard material. Provide plates made of steel with a urethane powder coat finish to match color of hood liner.

6. Ceiling Enclosure Panel: Used to enclose space between top of fume hood and ceiling on all exposed or open sides. Minimum 18 gage thick, finish to match hood. Provide 4 inches above ceiling for suspended ceiling to abut into and with a lower removable front panel for access to hood lights, piping and exhaust duct connections.
7. Fastenings:

    a. Interior fastening devices concealed. Exposed screws not acceptable.
    b. Exterior panel member fastening devices concealed. Exposed screws not acceptable.
    c. Exterior structural members attachments: Sheet metal screws, zinc plated.

C. Sill:

1. Bypass type designed to prevent reverse air flows or air eddies at the fume hood work surface. Sill to include an integral spill trough with hinged louvered horizontal panels that allows pass thru of hospital grade electrical plugs. Mount sill assembly flush with bottom of fume hood work surface. Provide a chemical resistant sealant between sill and work surface.

    a. Hinged slot panels patterns and size as follows:

        1) 48 inch wide fume hood: Two 19 inch long panels
        2) 72 inch wide fume hood: Two 31 inch long panels.
        3) 96 inch wide fume hood: Three 28-1/2 inch long panels.

2. Material: All components 16 gage thick Type 304 stainless steel, with an acid and abrasion resistant electrostatic epoxy or urethane powder coating. Color to be selected by the Owner’s Representative.

D. Sash:

1. Full view type with clear, unobstructed, side to side view of fume hood interior and service fixture connections. Vertical rising or combination vertical rising/horizontal sliding. Refer to Fume Hood Schedule for type and height of sash at each fume hood.
2. Vertical rising sash: 2 inches maximum height bottom sash rail, 18 gage thick steel with a polyurethane powder coat finish. Provide integral formed flush pull the full width of bottom rail. Set safety glass into rails in deep form, extruded polyvinyl chloride glazing channels. Open and close sash against rubber bumper stops.
3. Vertical rising sash operation: Provide sash stops at the design sash opening. Refer to the Fume Hood Schedule for sash stop height. Counterbalanced chain and sprocket system. Sash shall move smoothly without tilting or binding and shall remain at rest in any open position.
4. Horizontal sliding sash: Bottom H-shaped rail to be 18 gage thick stainless steel with stainless steel roller wheels set on 18 gage thick stainless steel track. Top track to be extruded polyvinyl chloride set in 18 gage thick stainless steel U-channel assembly. All stainless steel components finished with polyurethane finish. Color selection by the Owner's Representative.
5. Sash glass: 7/32 inch thick laminated safety glass.
6. Sash guides: Corrosion resistant polyvinyl chloride.

E. Liners:

1. Polyester liner: Reinforced glass polyester panel; smooth finish and white color in final appearance. Flexural strength: 21,000 psi. Flame spread: 25 or less per UL 723 and ASTM E84-80. Manufactured by WS Hampshire Inc. "Wesliner 1125". Provide gasketed access panels in the liner for access to valves and fixtures. Panels shall be of the same material as the liner and be provided with a PVC gasket to eliminate air leakage and retain liquids inside the hood.

F. Baffles:

1. Provide fixed baffles to control air vectors into and through the fume hood. Fabricate of the same material as the liner. All baffle supports and brackets to be non-metallic.
2. Baffle designs which permit close off of all slots are not acceptable.
3. Must comply with OSHA Lab Standard Guidelines.

G. Work Surfaces:

1. Molded epoxy resin: For hoods with Poly resin liners. Color to be selected by the Owner's Representative from the manufacturer's standard black, gray or white colors. Work surface as manufactured by Durcon Laboratory Tops; Kewaunee Scientific, Epoxyn Products; or, equal. 1-1/4 inches thick surface, dished 1/4 inch to contain spills.

H. Service Fixtures and Piping

1. Factory pre-pipe hoods compliant to all state and local codes with services indicated on the drawings, to a point of connection 2 inches above hood roof. Provide, per Division 22 the piping material and installation of each service type. Pressure test all prepiped lines in the factory.
2. Provide service fixtures within fume hoods with color coded, acid and solvent resistant plastic coating, applied over fine sandblasted surface, properly cleaned then sprayed and baked three times. With a minimum coating thickness of 6 mil.
3. Control Valves: Straight or 45 degree angle mounted fixtures on the front panel of the fume hood. Provide panel mounted or rod-type control valves as indicated on the Drawings. Mount the centerline of the valve inlet and outlet parallel and 1-1/8 inches apart. Provide valves with a threaded collar to hold the valve in place.
4. Color coding of hood interior service fixtures and remote control valves as specified for Laboratory Service Fixtures in Section: Laboratory Casework and Furnishings.
5. On fume hoods with pre-punched service fixture holes, provide metal or plastic plugs in color to match fume hood, for all unused holes.

I. Electrical:

1. Factory install receptacles, lighting, electrical fixtures and wiring in accordance with all applicable state and local codes and Division **26** specifications. Terminate wiring in a single service junction box on top of fume hood roof for in-the-field point of connection. All electrical fixtures shall be UL listed and labeled.

2. Wiring:

   a. Minimum #12 copper, type THHN/THWN insulation. Wire color coding shall be black for current carrying conductors, white for neutral conductors and green for ground conductors.

3. Conduit:

   a. Unless noted or required otherwise, ½ inch flexible metal or PVC conduit. Secure conduit to superstructure framework with conduit clamps. Conduit to light fixture to have a pigtail for ease of lamp maintenance.

4. Receptacles:

   a. Provide each hood with the receptacle quantities as follows:

      1) For 48 inch wide hoods: Provide one duplex receptacle each side post near the bottom.
      2) For 60 inch wide and greater hoods: Provide two duplex receptacles each side post near the bottom. Receptacles on each side shall be wired alternately.
      3) Provide a dedicated receptacle on top of all hoods for safety monitor and alarm.

   b. Receptacle: NEMA-5-20R, three wire grounding type receptacles rated at 120 VAC at 20 AMP with Ground Fault Interruption, Gray in color with stainless steel brushed finish flush face plate. Install receptacles with the ground outlet above the power slots. Label each receptacle with the associated circuit number.

5. Lighting:

   a. Fixture: Two lamp, rapid start, UL listed fluorescent light fixture with sound rated ballast installed on exterior of fume hood roof. Provide light fixture isolated from the hood interior by 1/4 inch thick laminated safety glass cemented and sealed to the hood roof. The lighting shall be serviceable from outside the fume hood interior.
   b. Interior of fixture: White, high reflecting plastic enamel.
   c. Size: Largest possible up to 48 inches for hoods with superstructures up to 6 feet. Provide Two 36 inches fixtures for hoods with 8 foot superstructures.
   d. Lamps: Include lamps with fixtures. Lamps and ballast to be the same type as specified in Division 26 for overhead lighting in laboratory spaces.
   e. Illumination: 80 footcandle minimum average at the worksurface.
   f. Light Switch: Toggle type, single pole 120 VAC, 20 AMP, Gray in color with stainless steel brushed finished flush face plate. Mount on left side of fume hood side post.

J. Exhaust Outlet:

1. Rectangular or round collar; 18 gage thick, Type 316 stainless steel.
2. For hoods with rectangular duct collars, provide exhaust duct transition from the hood rectangular exhaust collar to the building exhaust system round duct connection. Round duct size as indicated in the Fume Hood Schedule. Fabricate transition of the same material as the exhaust outlet.

K. Safety Monitor/Alarm System:

1. Variable volume hoods: Equip each fume hood with a velocity control and safety alarm unit which is provided under Division 23. Provide factory cut outs in the front of the hood for field mounting of the unit. Coordinate location and size of cut out with Division 23. Connection of control and safety alarm unit to sensors and control valves under Division 23.

L. Fume Hood Signage:

1. Operation Instructions: Provide a permanent acid resistant decal or plate attached to fume hood exterior with condensed information covering recommended locations for apparatus and accessories, baffle settings, use of sash, and recommended safe operating procedures.

2. Vertical Sash Stop Decal: Provide an acid resistant decal as detailed on the Drawings. Exact location to be determined when the fume hood is balanced.

3. Fume Hood Information/Certification Holder: Provide a 4 inch by 6 inch corrosion resistant metal or plastic frame attached to front face of fume hood exterior with plastic or glass glazing to contain a removable data card to identify hood and show hood characteristics and field test data.

2.4 FUME HOOD BASE AND SPECIAL CABINETS

A. Undercounter Flammable Storage Cabinets:

1. Acceptable Manufacturers:

   a. Justrite Manufacturing Company, L.L.C.

2. Design: Construct cabinets in accordance with OSHA Regulations and the requirements of NFPA 30, National Fire Protection Association, Flammable and Combustible Liquids Code. Provide cabinets Factory Mutual (FM) approved or Underwriters Laboratories (UL) listed. Cabinets shall limit the internal temperature at the center 1 inch from the top to not more than 325 degrees Fahrenheit when subjected to the fire test for storage cabinets as described in NFPA 30.
3. Casing: Bottom, top, back, door, and sides of cabinet shall be at least 18 gage sheet steel, double walled with 1-1/2 inch air space. Joints shall be welded airtight. Provide with adjustable zinc plated leveling legs.
4. Door: Provide with continuous piano hinge and a 3-point latching arrangement with door sill raised at least 2 inches above the bottom of the cabinet to retain spilled liquid within the cabinet. When more than 1 door is used, there shall be a rabbetted overlap of not less than 1 inch. Provide self-closing, self-latching door(s) with fusible link(s) to hold doors wide open and melt at 165 degrees Fahrenheit for automatic closure. Provide with keyed lock.

5. Ventilation: Do not ventilate cabinet unless required by local authorities. Seal vent openings with plugs, supplied by the manufacturer.][Vent cabinets to building supply and exhaust systems as indicated on the Drawings, with 2 inch Schedule 40 steel piping. Provide flash arrestors at supply and exhaust connections to cabinet.
6. Shelving: Provide each cabinet with a full width adjustable shelf.
7. Grounding: Provide a grounding lug connection at back of cabinet.
8. Identification: Mark all flammable storage cabinets with conspicuous red lettering on a contrasting background: FLAMMABLE - KEEP FIRE AWAY.
9. Color: Manufacturer's standard yellow.

B. Undercounter Corrosive Storage Cabinets:

1. Acceptable Manufacturers:

a. Justrite Manufacturing Company, L.L.C.

2. Design: Construct cabinets in accordance with OSHA Regulations and the requirements of International Fire Code, Chapter 27 Hazardous Materials – General Provisions. Provide cabinets Factory Mutual (FM) approved or Underwriters Laboratories (UL) listed.
3. Casing: Bottom, top, back, door, and sides of cabinet shall be at least 18 gage sheet steel, double walled with 1-1/2 inch air space. Joints shall be welded airtight. Provide with adjustable zinc plated leveling legs.
4. Door: Provide with continuous piano hinge and a 3-point latching arrangement with door sill raised at least 2 inches above the bottom of the cabinet to retain spilled liquid within the cabinet. When more than 1 door is used, there shall be a rabbetted overlap of not less than 1 inch. Provide self-closing, self-latching door(s) with fusible link(s) to hold doors wide open and melt at 165 degrees Fahrenheit for automatic closure. Provide with keyed lock.
5. Ventilation: Provide a 2 inch polypropylene vent pipe at the outside rear of the cabinet with 2 inlets, 1 high and 1 low. Extend vent pipe to 4 inches above the hood work surface.
6. Shelving: Provide each cabinet with a full width adjustable shelf.
7. Liner: Provide cabinet with ChemCor thermoplastic coating on all interior surfaces as provided on the Justrite Centura line.
8. Bottom Pan: Provide with 1/4 inch thick heat welded, polypropylene or ABS plastic pan, liquid tight, removable, 1 inch deep.
9. Hardware: All exposed to outside and inside of cabinet shall be Stainless Steel.
10. Identification: Mark all undercounter ventilated cabinets with conspicuous red lettering on a contrasting background: HAZARDOUS – KEEP FIRE AWAY.
11. Color: Manufacturer's standard dark blue.

2.5 SOURCE QUALITY CONTROL TESTING OF EPOXY RESIN WORK SURFACE

A. As specified for Source Quality Control Testing of Epoxy Resin Work Surface in Section: Laboratory Casework and Furnishings.

2.6 SOURCE QUALITY CONTROL TESTING OF POLY RESIN LINER

A. Test Procedure:

1. Test Number 1 - Spills and Splashes:

a. Suspend in a vertical plane a 42 inch horizontal by 12 inch vertical panel divided into 3/4 inch wide vertical columns.
b. Apply 5 drops of each reagent listed with an eye dropper.
c. Apply liquid reagents at top of panel and allow to flow down full panel height. "CAUTION! Flush away any reagent drops."

2. Test Number 2 - Fumes and Gases:

a. Divide 24 inch by 12 inch panel into 2 inch squares.
b. Place 25 milliliters of reagent into 100 milliliter beakers and position panel over beaker tops in the proper sequence. Note: Beaker pouring lip permits atmospheric oxygen to enter and participate in the reaction of the reagent fumes.

3. After 24 hours remove panel, flush with water, clean with naphtha and detergent, rinse, wipe dry and evaluate.

B. Evaluation ratings: Change in surface finish and function shall be described by the following ratings:

1. No Effect: No detectable change in surface material.
2. Excellent: Slight detectable change in color or gloss, but no change to the function or life of the work surface material.
3. Good: Clearly discernible change in color or gloss, but no significant impairment of work surface function or life.
4. Fair: Objectionable change in appearance due to surface discoloration or etch, possibly resulting in deterioration of function over an extended period.
5. Failure: Pitting, cratering or erosion of work surface material; obvious and significant deterioration.

C. Test Results: Submit a report of the test results. The results shall be equal to or better than the following:

	Reagent List Concentrations by Weight	Test1 Rating Spills	Test 2 Fumes
1.	Sodium Hydroxide	No Effect	No Effect
2.	Sodium Hydroxide, 40%	No Effect	No Effect
3.	Sodium Hydroxide, 20 percent	No Effect	No Effect
4.	Sodium Hydroxide, 10 percent	No Effect	No Effect
5.	Ammonium Hydroxide, 28 percent	No Effect	No Effect
6.	Methylene Chloride	No Effect	No Effect
7.	Chloroform	No Effect	No Effect
8.	Carbon Tetrachloride	No Effect	No Effect
9.	Monochlorobenzene	No Effect	No Effect
10.	Tincture of Iodine	No Effect	Good
11.	Methyl Alcohol	No Effect	No Effect
12.	Ethyl Alcohol	No Effect	No Effect
13.	Butyl Alcohol	No Effect	No Effect
14.	Phenol, 85 percent	No Effect	Excellent
15.	Cresol	No Effect	No Effect
16.	Sodium Sulfide	No Effect	No Effect
17.	Furfural	Excellent	Excellent
18.	Dioxane	No Effect	No Effect
19.	Zinc Chloride	No Effect	Excellent
20.	Benzene	No Effect	No Effect
21.	Toluene	No Effect	No Effect
22.	Xylene	No Effect	No Effect
23.	Gasoline	No Effect	No Effect
24.	Naphthalene	No Effect	No Effect
25.	Methylethyl Ketone	No Effect	No Effect
26.	Acetone	No Effect	No Effect
27.	Ethyl Acetate	No Effect	No Effect
28.	Amyl Acetate	No Effect	No Effect
29.	Ethyl Ether	No Effect	No Effect
30.	Silver Nitrate, 10 percent	Excellent	Excellent
31.	Dimethylformamide	Excellent	Excellent
32.	Formaldehyde, 37 percent	No Effect	No Effect
33.	Formic Acid, 88 percent	No Effect	Excellent
34.	Acetic Acid, Glacial	No Effect	No Effect
35.	Dichloroacetic Acid	No Effect	Excellent
36.	Chromic Acid, 60 percent	No Effect	No Effect
37.	Phosphoric Acid, 85 percent	No Effect	No Effect
38.	Sulfuric Acid, 33 percent	No Effect	Excellent
39.	Sulfuric Acid, 77 percent	No Effect	No Effect
40.	Sulfuric Acid, 93 percent	No Effect	No Effect
41.	Hydrogen Peroxide, 30 percent	No Effect	No Effect
42.	Acid Dichromate	No Effect	No Effect
43.	Nitric Acid, 20 percent	No Effect	Excellent
44.	Nitric Acid, 30 percent	No Effect	No Effect
45.	40 & 47 Equal Parts	No Effect	Good
46.	Nitric Acid, 70 percent	No Effect	Good
47.	Hydrofluoric Acid, 48 percent	No Effect	Excellent
48.	Hydrochloric Acid, 37 percent	No Effect	Excellent

2.7 SOURCE QUALITY CONTROL TESTING OF FUME HOODS

A. Test one fume hood of each type and size specified in accordance with the method prescribed in American National Standard ANSI/ASHRAE 110-1995 or latest edition. The minimum overall performance rating of each test, 4.0 AM 0.05 with 4.0 the tracer gas release rate in liters per minute, AM identifying an "as manufactured" test, and 0.05 indicating the maximum level of tracer gas, in parts per million, in the breathing zone.

B. Hood test: In the manufacturer's test facility with testing personnel, samples, apparatus, instruments, and test materials supplied by the manufacturer.

2.8 Source Quality Control Testing Of Fume Hoods

A. Submit a test report, for each type and size of hood, for the standard product previously tested, if the product is identical to equipment being provided for this project.

B. Conduct an evaluation of standard product in the manufacturer's test facility in accordance with the method prescribed in ANSI/ASHRAE 110-1995 or latest edition.

C. Hoods: Achieve a rating of 4.0 AM 0.05 with 4.0 being the tracer gas release rate in liters per minute, AM identifying an "as manufactured" test, and 0.05 indicating the maximum level of tracer gas, in parts per million, in the breathing zone.

2.9 SOURCE TESTING OF FUME HOOD SOUND LEVELS

A. Provide the following historic certified sound test data for each size and type of fume hood:

1. Background sound pressure level readings for the test facility with exhaust system operating but without connection to the fume hood.
2. A second set of readings recorded with the fume hood connected and operating and the sensor located 36 inches in front of the sash assembly.
3. Certified report: Octave band sound pressure level, Db re 20 micro Pa in the 31.5 to 8,000 Hertz frequency range, for the fume hood operating.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION, GENERAL

A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:

1. Respective manufacturer/fabricator’s written installation instructions.
2. Accepted submittals.
3. Contract Documents.

B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by isolating metals and other materials from direct contact with incompatible materials.

3.3 PREPARATION

A. General: Comply with manufacturer's instructions, recommendations, and specifications for cleaning and surface preparation. Surfaces shall have no defects, contaminants, or errors which would result in poor or potentially defective installation or would cause latent defects in Work.

3.4 INSTALLATION

A. Installation

1. Install fume hoods and equipment in accordance with manufacturer's instructions.
2. Install equipment plumb, square, and straight with no distortion and securely anchored as required.
3. Secure work surfaces to casework and equipment components with material and procedures recommended by the manufacturer.

B. Accessory installation: Install accessories and fixtures in accordance with manufacturer's recommendations.

3.5 FIELD QUALITY CONTROL TESTING OF FUME HOODS

A. Manufacturer/Fabricator's Field Service: Manufacturer/fabricator's qualified technical representative shall inspect first day's Work and periodically inspect Work to ensure installation is proceeding in accordance with manufacturer/fabricator's designs, recommendations, instructions, and warranty requirements. Representative shall submit written reports of each visit indicating observations, findings, and conclusions of inspection.

B. Owner's Testing Agency Field Service: The Owner may employ and pay a qualified independent testing agency to perform field quality control. Materials and installation failing to meet specified requirements shall be replaced at Contractor's expense. Retesting of materials and installations failing to meet specified requirements shall be done at Contractor's expense.

C. ADP FH Testing Companies

1. B & V Testing, Inc.
2. Exposure Control Technologies, Inc.
3. Indoor Air Professionals
4. Safety Plus LLC
5. Technical Safety Services, Inc.

D. Testing Requirements

1. Commission each fume hood in accordance with the test procedures prescribed in American National Standard ANSI/ASHRAE 110-1995 or latest edition.
2. The fume hood commissioning agent: A third party and not a representative of the manufacturer or installation contractor.
3. Provide the Owner's Representative two weeks prior notice of the testing start date.

E. Testing Conditions

1. Conduct tests under conditions as specified under Paragraph 5.1.1 of ANSI/ASHRAE 110-1995 or latest edition.
2. Commence fume hood commissioning immediately after the final Test and Balance Report has been approved and before the Owner has occupied the laboratory.
3. Verify that the building makeup air system is in operation, the doors and windows are in normal operating position, and that all other hoods and exhaust devices are operating at design conditions.
4. Correct any unsafe conditions disclosed by these tests before request of test procedures.

F. Instrumentation and Equipment

1. Employment instrumentation and equipment as specified under Article 4 of ANSI/ASHRAE 110-1995 or latest edition.

G. Flow Visualization Test

1. Conduct both Local Visualization and Large Volume Visualization Tests in accordance with ANSI/ASHRAE 110-1995, Article 6.1 or latest edition.
2. If there is visible smoke flow out of the front of the hood, the hood fails the test.

H. Face Velocity Test

1. Provide face velocity measurements as outlined in Articles 6.2, 6.3 and 6.4 of ANSI/ASHRAE 110-1995 or latest edition.

I. Tracer Gas Test

1. Provide a tracer gas test for each fume hood in accordance with the procedures specified under Article 7 of ANSI/ASHRAE 110-1995 or latest edition.
2. Hoods shall achieve a rating of 4.0 AI 0.10, with 4.0 being the tracer gas release rate in liters per minute, AI identifying an "as installed" test, and 0.10 indicating the maximum level of tracer gas, in parts per million, in the breathing zone.

J. Test Reports

1. Provide a test report for each test for each hood. Include in report a record of all measurements and an indication of test "pass" or "failure".
2. Submit six (6) copies of the test repot for approval.

3.6 ADJUSTING

A. Repair or remove and replace defective work, as directed by the Owner's Representative upon completion of installation.

B. Adjust sash, fixtures, accessories and other moving or operating parts to function smoothly.

3.7 CLEANING

A. Clean equipment, touch up as required.

3.8 PROTECTION OF FINISHED WORK

A. Provide all necessary protective measures to prevent damage to equipment from exposure to other construction activity.

B. Advise Contractor of procedures and precautions for protection of material and installed fume hoods from damage by work of other trades.

END OF SECTION

SECTION 115319 - LABORATORY STERILIZERS, GLASSWARE WASHER, CAGE AND BOTTLE WASHER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Medium Steam Sterilizers
2. Glassware Washer
3. Cage and Bottle Washer

B. Related Sections:

1. Division 22: Furnishing and installation of plumbing utilities and final connections to equipment.
2. Division 23: Furnishing and installation of exhaust ductwork and final connection to equipment.
3. Division 26: Furnishing and installation of electrical utilities and final connections to equipment.

1.2 REFERENCES

A. The following industry, association and government codes and standards are cited in this Section. They shall be followed as applicable to the design, fabrication, assembly and testing of the specified equipment.

1. American Society for Testing and Materials (ASTM).
2. Federal Occupational Safety and Health Act (OSHA).
3. National Fire Protection Association (NFPA).
4. Underwriters Laboratories, Incorporated (UL).
5. American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section IX.
6. National Electric Manufacturers Association (NEMA).
7. National Electric Code (NEC).
8. American Society of Mechanical Engineers (ASME), Unified Pressure Vessel Code, Section VIII.
9. American Welding Society (AWS).
10. American National Standards Institute (ANSI).

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's data for each item of equipment specified. Include dimensions, configurations, construction details, and attachments. Indicate location, size, and service requirements for each utility connection.

B. Shop Drawings: Provide large scale plans and sections showing rough-in and anchor placements, clearances, and location of utilities for coordination with other trades.

C. Test Reports: Submit test reports verifying conformance to specified performance tests.

D. Manufacturer's operating and maintenance manuals.

E. Provide calibration prior to installation.

F. Provide qualification (IQ/OQ/PQ) prior to installation.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Modern plant with proper tools, dies, fixtures and skilled workers to produce high quality equipment and meeting the following minimum requirements:

1. Ten years or more experience in manufacture of the type of equipment specified.

2. Ten installations of equal or larger size.

B. Installer's Qualifications: Factory trained and/or certified by the manufacturer.

1.5 DELIVERY, STORAGE AND HANDLING

A. Delivery: Schedule delivery of equipment so that spaces are sufficiently complete that equipment can be installed immediately following delivery.

B. Handling: Protect finished surfaces from soiling or damage during handling and installation. Keep covered with polyethylene film or other protective coating.

1.6 PROJECT CONDITIONS

A. Do not deliver or install equipment until the following conditions have been met:

1. Windows and doors are installed and the building is secure and weathertight.
2. Ceiling, overhead ductwork and lighting are installed.

1.7 WARRANTY

A. Manufacturer’s Warranty: Furnish manufacturer’s written material and labor warranty signed by an authorized representative using manufacturer’s standard form agreeing to furnish materials and labor required to repair or replace work which exhibits material defects caused by manufacture or design and installation of product. “Defects” is defined to include but not limited to deterioration or failure to perform as required.

1. Coverage of warranty includes but is not limited to the following:
2. Warranty Period: Manufacturer shall warrant the products to be free from material and labor Defects for a period of 1 year from date of Substantial Completion

B. Installer’s Warranty: Furnish installer’s written workmanship warranty signed by an authorized representative using installer’s standard form agreeing to provide labor required to repair or replace work which exhibits workmanship defects. “Defects” is defined to include but not limited to deterioration or failure to perform as required.

1. Warranty Period: Installer shall warrant the installation to be free from workmanship Defects for a period of 1 year from date of Substantial Completion.

C. For ASME stamped sterilizer pressure vessels, provide a 15 year warranty against structural failure. Warranty shall start at completion of installation and startup.

PART 2 - PRODUCTS

2.1 MEDIUM STEAM STERILIZERS

A. Available Manufacturers: Subject to compliance with requirements of Contract Documents as judged by the Architect, manufacturers offering products that may be incorporated into the Work include, but are not limited to, those listed.

1. Steris Corporation (Model AMSCO CENTURY)

B. Construction:

1. Size: refer to drawings for chamber sizes.

2. Chamber and Jacket: Type 316L stainless steel chamber. Welded pressure vessel construction in accordance with the requirements of ASME Code, Section VIII for unfired pressure vessels. Design for a minimum working pressure of 40 psig and full vacuum. The vessel shall be stamped and a signed copy of the U-1 form furnished. Provide vessel with an ASME approved and stamped safety valve.

3. Insulation: Minimum 1 inch thick foil backed glass fiber to cover the jacket of the assembly.
4. Doors: Type 316L stainless steel. Provide with self aligning gasket for a positive seal when the door is closed. Design to lock automatically when chamber pressure is positive and to unlock only when pressure is reduced to approximately atmospheric.
5. Support Structure: Provide with height adjustable steel stand with floor pads and leveling screws. Stand to have corrosion resistant coating. Provide with seismic tie-down kit.

C. Enclosure:

1. Facia and enclosure material: Type 304 stainless steel polished to a Number 4 finish; minimum 16 gage.
2. Cabinet enclosed units: Door facing, front finishing panels and complete enclosure.
3. Provide service access panels in all enclosed units.
4. Door swings shall be as indicated on the Drawings.

D. Control System:

1. Microprocessor based system to monitor and control all phases of the sterilizer operation.
2. Provide control panel with window display and touch pad controls. Display shall indicate sterilizer status, time of day, cycle times, temperature, pressure, and any warnings or instructional message.
3. Mount panel on operating end of unit and provide front panel service access to microprocessor control boards and associated electronics.
4. The control system shall be factory programmed with standard sterilizing cycles. Each cycle shall be field adjustable, through cycle selector and value change touch pads, to meet specific processing requirements. The system shall provide the operator with the capability to change cycle parameters from the control panel.
5. Provide control system with a printer to continuously record on a strip chart cycle identification, cycle progression, selected parameters, date, time, chamber temperature, chamber pressure, alarms, and diagnostics.
6. Provide the following cycle safeguards:

    a. Cycle inoperative unless doors are closed and locked.
    b. Rejection of incorrect cycle parameters.
    c. Automatic condensing of chamber steam and disposal of condensate to waste. Condensate discharge temperature shall not exceed 140 degrees Fahrenheit.

7. Control system shall include a security access code to prevent cycles and cycle values from being changed by unauthorized personnel.
8. Provide the control system with nonvolatile memory storage or battery backup to protect all cycle memory.

E. Safety Devices:

1. Control lockout switch: Provide on chamber door to prevent cycle from starting until door is closed and seal is energized.
2. Chamber float switch: Install to abort cycle and vent chamber if excessive condensate is detected in the chamber.
3. Pressure relief valve: Provide to limit the internal pressure from exceeding the pressure rating of the vessel. Pipe from outlet of valve down to floor sink with proper air gap.

F. Piping:

1. Terminate all connections within the confines of the sterilizer, accessible from the front and side of the unit.

2. Steam Piping: Provide with shutoff valve, steam strainer, pressure regulator, and control valves.
3. Water Piping: Provide with shutoff and control valves.
4. For units requiring compressed air for operation of door, door seals, or controls, if compressed air is not available then provide integral air compressor with the unit.

G. Options:

1. Load Probe, Control End: Provide temperature probe permitting placement in the load to be sterilized. Sterilization cycle time based on load temperature.
2. Automatic Jacket Blowdown: Provide exhaust from jacket to prevent liquid loads from boiling over.
3. Multi-Rate Liquid Exhaust: Optimize the exhaust rate to prevent boil over of liquids and reduce cycle time.

H. Accessories:

1. Provide loading cars and carriages for sterilizers. Construct loading cars of stainless steel or monel metal and carriages of stainless steel.

a. Quantity: Single door units provide one loading car and carriage for each unit.

I. Integral Electric Clean Steam Generator:

1. Provide an integral electrically powered clean steam generator.
2. Electrical Power: As scheduled on the drawings.
3. Control Power: As scheduled on the drawings.
4. Construct of carbon steel in accordance with the requirements of the ASME Boiler and Pressure Vessel Code, Section 1, Miniature Boilers.
5. Include a turbine type feed water pump powered by a continuous duty 3-phase motor.
6. Feed water piping shall include shutoff valve, strainer and vacuum breaker.
7. Steam generator and feed water pump shall operate automatically whenever the sterilizer is on. Interface generator with sterilizer flood fail safe controls.
8. Provide unit with operating and safety controls, including low water cutoff, boiler feed water valve, and ASME approved safety valve.
9. Provide an automatic blowdown that incorporates a motorized ball shutoff valve that automatically uses steam pressure to minimize mineral accumulation in the steam boiler. Provide with a seven-day timer that allows the user to select a time each day to schedule the blowdown function.

2.2 GLASSWARE WASHER

A. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents as judged by the Architect, provide product by one of manufacturers listed. If not listed, submit as substitution according to the Conditions of the Contract and Division 01 Section “Substitution Procedures”.

B. Acceptable Manufacturers:

1. Gettinge Life Sciences (GEW 8668)

2. Labconco (Model Flaskscrubber 4420330)

3. Steris Corporation (Model Reliance 100LS)

2.3 WASHER DISINFECTOR

A. Product Description:

1. The chamber size shall be minimum 26"W x 26"H x 31"D.

2. The washer shall be designed for manual, single door vertical operation with a full glass door and shall have a modular wall style enclosure. The interior of the wash chamber shall be illuminated. The chamber shall be insulated.

3. The entire unit including cabinet and piping shall be fabricated of 302/304 stainless steel and all exposed surfaces to have a #4 finish. The pump shall be fabricated of the same material.

4. The washing action should be accomplished by hydraulically operated stainless steel rotary headers and/or spindle headers. The wash chamber shall be fitted with quick locking device(s) for automatic connection of interchangeable headers to the pump recirculating piping. A pulsed detergent wash for restricted orifice glassware should be included. Provide an automatic detergent dispenser.

5. The washing cycle shall consist of a pre-wash (selectable cold, hot or very hot), detergent wash (selectable hot or very hot), first rinse (selectable hot or very hot), third rinse (selectable hot or very hot) and up to three automatic independent pulses of reagent grade water delivered in stainless steel piping. Hot water is 140°F; very hot water is 180°F.

6. Unit shall be equipped with an optional integral drying system consisting of a minimum 1.5 HP blower and electric heaters. System shall heat air to a minimum of 240°F (116°C). The air shall be recirculated through the accessories and the chamber while a portion is exhausted to [room] OR [optional vent connection]. Air shall be directed through each spindle to allow for fast drying.

7. Unit shall be equipped with a full microprocessor control package that includes sealed LED cycle membrane touch pad, status displays and cycle end/low detergent audible/visual alarm.

8. Unit shall be equipped with a stainless steel heated water tank with stainless steel steam coil to raise building supplied hot water to 180°F. Hot water will be fed by building system.

9. Deionized (DI) or Reverse Osmosis (RO) Water System. Provide one (1) DI water source for two (2) GWD glassware washers. System will be equipped to generate peek DI water necessary to operate two glassware washers simultaneously during and any phase of wash cycle. The fully automatic DI water system will be integrated within the service areas of the washers. The DI water will be Type III.

10. Equipment Options:

    a. Drying Package: [Without Integral Drying System] OR [Integral Drying For Vented Exhaust] OR [Integral Drying With No Building Exhaust].
    b. Heating Source:[Steam Coil Tank Heater
    c. Special Rinse: [Purified Water Valve – Standard] OR [Valve with Lower Pressure Booster Pump]
    d. Cycle Printer: Mounted on Load Side Only

11. Provide the following with each unit:

    a. Multiple loading system.
    b. Drain discharge cool-down system to reduce discharges to 140°F or less.
    c. Integral canopy/vent hood.
    d. Modular wall enclosure with access door; enclosure to ceiling; framing to structure above.
    e. Vented Drying System – Equipment shall be installed and connected to the customer's exhaust vent system. The machine's integral condensing system collapses the moist vapor exhaust, sending the waste water to drain. A hooded vent connection with 140-175 CFM shall be provided by others to carry away the excess.

f. Rack Identification and Auto Start Only – Equipment shall be equipped with chamber sensors and controls to recognize magnet codes on dedicated wash carts in order to automatically run a predetermined cycle. Wash carts shall be manually loaded. Cycle will be automatically selected and started once the load door has been closed.

g. Heated Holding Tank for Final Rinse – Equipment shall be equipped with a mounted holding tank, valves, controls and an optional integral steam coil or electrical coil. During operation the tank fills with final rinse water, pre heats the water to the operator specified temperature and maintain temperature until the final rinse phase is reached. Washer tank is then filled with the pre-heated rinse water, saving time that would be required to heat up fresh rinse water.

h. Integral Cycle Printer – Equipment shall be fitted with an integral printer mounted above the control panel to provide hard copy record of cycle phase performance.

12. Provide at the time of bid a complete list of headers and accessories for selection by the owner. Include unit prices for all included items.

13. Utility requirements:

	Services Pipe Size To Washer	Pressure Range Dynamic	Flow Rate	Temperature	Consumption Per Cycle
Cold Water 3/4" (20mm) NPT Coupling	1" NPT (25mm)	30-60 PSIG (200-400 kPa)	6-8 GMP (23-30 l/MIN)	Not to exceed 90 Deg F (32 Deg C)	8.72 GAL/PHASE (33 LITERS)
Hot Water 3/4" (20mm) NPT Coupling	1" NPT (25mm)	30-60 PSIG (200-400 kPa)	6-8 GMP (23-30 l/MIN)	110-140 DEG F (43-60 Deg C)	8.72 GAL/PHASE (33 LITERS)
Purified Water 3/4" (20mm) NPT Coupling	1" NPT (25mm)	8-60 PSIG (50-400 kPa)	5-9 GMP (19-34 l/MIN)	N/A	8.72 GAL (33 LITERS)
Drain 2" (50mm) Dia	N/A	N/A	20 GPM MINIMUM	N/A	N/A
Exhaust Duct 3" (75mm) Dia	N/A	N/A	140-175 CFM	120-140 Deg F (49-60 Deg C)	N/A
Steam 1/2" (13mm) NPT	3/4" NPT (20mm)	45-90 PSIG (300-500 kPa)	2.3 LB/MIN Peak (1.04 kg/MIN) 1-2 LB/MIN Avg (.45-.91 kg/MIN)	N/A	1.43 LB/MIN (0.65 kg/MIN)
Condensate Return 1/2" (13mm) NPT	3/4" NPT (20mm)	N/A	N/A	N/A	N/A
Compressed Air 1/8" (3mm) Quick Connect	1/4" NPT (6mm)	60-80 PSIG (400-530 kPa)	N/A	N/A	N/A

	Steam Heated		Electric Heated	
	w/o Drying	w/ Drying	w/o Drying	w/ Drying
Electrical 208 V, 3PH, 60 Hz	20A, 2.5KW	30A, 6.9KW	60A, 17.5KW	60A, 17.5KW

Electrical 230-240V, 3PH, 50/60 Hz	16A, 2.5KW	20A, 6.9KW	50A, 17.5KW	50A, 17.5KW
Electrical 380-415V, 3PH, 50/60 Hz	10A, 2.5KW	16A, 6.9KW	35A, 20.5KW	35A, 20.5KW

14. Unit shall carry a one (1) year warranty for parts and labor.

B. Unit(s) shall be equal to Getinge #8666 Washer Disinfector. Unit(s) manufactured by ABC Corporation shall be considered equal provided that they meet requirements of this specification.

C. Equipment Schedule:

1. Getinge USA, Inc. Model #8666
2. Chamber Size: 26”W x 26”H x 28”D
3. Single Door
4. Recessed through one wall

2.4 CAGE AND BOTTLE WASHER

A. Manufacturers: Products, which comply with this specification section as judged and approved by the Architect, may be provided by the following manufacturers. All products specified in this section shall be the provided by a single manufacturer.

1. Steris Corporation, 5960 Heisley Road, Mentor, Ohio 44060 Tel: 440 354-2600.

2. Getinge/Castle, Inc., 1777 East Henrietta Road, P.O. Box 93070, Rochester, NY 14692 Tel: 800 541-5569.

3. Scientek, 11151 Bridgeport Road, Richmond, BC V6X 1T3, Canada Tel: 604 273-9094.

4. Approved equal.

B. Basis of Design: Basil Model 3700 Cage And Bottle Washer, single door, or equivalent.

C. Description: A heavy duty, cabinet type hydrospray washer designed for thorough, efficient cleaning of cages, bottles, debris pans and miscellaneous items used in the care of laboratory .

D. Size:

1. Compartment: 48 inches wide x 31 inches high x 34 inches deep (1219 mm wide x 787 mm high x 864 mm deep).

2. Overall Machine: 77 inches wide x 80 inches high x 38 1/2 inches deep (1956 mm wide x 2032 mm high x 978 mm deep).

E. Washing Cycles: Programmable washing cycles shall include the following phases:

1. Pre-Wash: Water remaining in the chamber sump from final rinse of the previous cycle shall be recirculated through the jet system under pump pressure and pumped to drain upon completion.

2. Wash: Hot water from house supply shall fill the chamber sump and detergent shall be added using optional or customer-supplied detergent injection pump. Solution shall be pumped through the jet system and pumped to drain upon completion.

3. Acid Wash: Hot water from house supply shall fill the chamber sump and acid detergent (Optional) shall be added using optional or customer-supplied detergent injection pump.

Cycle may be programmed to allow acid to work for a period of 0-10 minutes after acid recirculation has ceased. Solution shall be pumped through the jet system and pumped to drain upon completion.

4. First and Second Rinse Cycles: Hot water from house supply shall fill the chamber sump and shall be recirculated through the jet system under pump pressure. At the end of the treatment, water shall be pumped to drain.

5. Final Rinse: As first rinse except at the end of the treatment, the water may be retained in the chamber sump to be used as the pre-wash water for the subsequent load.

6. Exhaust: Washer shall stand idle for a sufficient length of time to remove the residual vapors.

F. Construction:

1. The base, wash chamber and chamber sump: welded stainless steel construction with integral supports for pump.

2. Door(s) shall be of double wall, insulated construction and fitted with a tempered glass observation window.

3. The stainless steel steam coil heating in chamber sump shall be complete with condensate return, steam trap, and strainer. Steam coil shall be designed to ASME Section VIII, Div. 1, Unfired Pressurized Vessel Code, and shall be easily removable for cleaning or maintenance. Coil shall not be welded in place.

4. Safety Switch: Shall be fitted to the chamber door(s) which will stop all washer operations if door is opened during the cycle.

5. Insulation: Washer shall be insulated with 2 inch (50 mm) thick rigid fiberglass insulation, covered by protective stainless steel panels.

G. Control:

1. Washer shall be provided with a microcomputer control system that monitors and automatically controls all process operations and functions. Cycle phase times and temperatures and other key process parameters shall be programmable and shall be capable of being locked in by supervision.

2. A display screen shall display cycle program data on demand and real time in-process cycle performance.

3. An integral printer shall record all cycle program and in-process performance data.

H. Required Options:

1. Pass-Through Unit: Washer shall be provided with an additional door for pass-through operation. Additional door shall be equipped with safety switch and meets all requirements previously stated. A secondary control column shall be mounted on the non-operating/unload end and can be used to initiate cycles.

2. Electric Sump Heaters, equipped with stainless steel elements, shall be provided to heat the treatment solutions in lieu of steam coils.

3. Acid Detergent System: The washer shall have the ability to have a separate acid detergent treatment after the alkaline wash.

4. Acid Detergent System and Automatic Acid Detergent Injection System.

5. Exhaust Fan: Washer shall be provided with a fan interwired with the control system to exhaust residual vapors from within the wash chamber.

6. Vapor Condenser Exhaust System: The washer shall be equipped with a vapor condenser to remove residual vapors from within the wash chamber and direct condensed vapors to drain.

7. Steam Heat Exchanger: The washer shall be equipped with an in-line steam to water heat exchanger.

8. Drain Discharge Cool Down System.

9. Automatic Alkaline Detergent Injection System.

10. Automatic Neutralizer Injection System.

11. pH Neutralization and Detergent System.

12. Seismic Tie Down: Washer shall be designed to comply with Seismic Zone 3 & 4 requirements.

I. Required Accessories:

1. Stainless Steel 32 Mouse Box Rack.

2. Stainless Steel 48 Mouse Box Rack.

3. Stainless Steel 12 Rat Box Rack.

4. Stainless Steel 18 Rat Box Rack.

5. Stainless Steel Pan Rack.

6. Stainless Steel Transfer Cart.

2.5 EQUIPMENT ENCLOSURE PANELS

A. Manufacturer: Stainless steel equipment enclosure panels shall be provided by the equipment manufacturer to match the finish of the enclosed equipment where indicated on the Laboratory Furnishing drawings.

B. Materials:

1. Panels: 18 gauge (1.3 mm thick), type 304 stainless steel.

2. Trim angles and corner posts: 16 gauge (1.6 mm thick), type 304 stainless steel.

3. Access doors: Sandwich panel consisting of 18 gauge (1.3 mm thick) exterior panel and 20 gauge (1.0 mm thick) interior panel, type 304 stainless steel.

4. Insulation: Sound deadening, moisture-resistant mineral fiber. Insulation shall be asbestos-free.

5. Density: 5 lbs/cu ft (80 kg/m^3).

6. Thickness: 1/2 inch (12.7 mm).

C. Construction:

1. Refer to details and plans on the Laboratory Furnishing drawings. Refer to Section 11602, Stainless Steel Fabrications.

2. Provide insulation to the backside of all panels, trim angles, and corner posts. Provide insulation between the two panels of the access doors.

3. Finish: No. 3 or No. 4 stainless steel finish to match equipment.

D. Hardware:

1. Hinge: Continuous, stainless steel with stainless steel pin.

2. Latch: Keyed spring lock assembly with manual release on the inside.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION, GENERAL

A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:

1. Respective manufacturer/fabricator’s written installation instructions.
2. Accepted submittals.
3. Contract Documents.

3.3 INSTALLATION

A. Deliver to job site, uncrate, place in location, and assemble all equipment specified herein. Remove all debris and crating materials.

B. Install equipment in strict accordance with the manufacturer's recommendations, including maintaining recommended operating and servicing clearances.

C. Provide shutoff valves in all utility supply piping to the units.

D. Provide and install with a seismic tie-down kit.

3.4 FIELD QUALITY CONTROL

A. Include the services of the manufacturer's factory trained field representative to inspect and provide written approval of the installation.

B. Include the services of the manufacturer's representative to start up and test the equipment, and to instruct the Owner or the Owner’s operating personnel in the proper care and operation of the unit. The manufacturer shall certify in writing that the equipment is operating according to specifications.

3.5 ADJUSTING

A. Repair or remove and replace defective work, as directed by the Owner's Representative upon completion of the installation.

B. Adjust equipment to function smoothly.

3.6 CLEANING

A. Clean equipment, touch up as required.

3.7 PROTECTION OF FINISHED WORK

A. Provide all necessary protective measures to prevent damage to equipment from exposure to other construction activity.

END OF SECTION 115319

SECTION 122413 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Motor-operated roller shades with single rollers.

a. Where head of window is 10 feet or more above finished floor.
b. Where indicated.

2. Manual-operated roller shades with single rollers.

a. Where head of window is less than 10 feet above finished floor.
b. Where indicated.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" and/or Section 092216 "Cold-Formed Metal Framing" for blocking / backing and ceiling reinforcing for mounting roller shades and accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

B. Sustainable Design: Product data for shadeband materials, indicating compliance with sustainable design performance requirements.

C. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.

1. Motor-Operated Shades: Include details of installation and diagrams for power, signal, and control wiring.

D. Samples for Initial Selection: For each type and color of shadeband material.

1. Include Samples of accessories involving color selection.

E. Samples for Verification: For each type of roller shade.

1. Shadeband Material: Not less than 10 inches square. Mark inside face of material if applicable.
2. Roller Shade: Full-size operating unit, not less than 16 inches wide by 36 inches long for each type of roller shade indicated.
3. Installation Accessories: Full-size unit, not less than 10 inches long.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and installer.

B. Product Certificates: For each type of shadeband material, signed by product manufacturer.

C. Product Test Reports: For each type of shadeband material, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roller shades to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm with not less than 10 years' experience regularly engaged in the production and sales of roller window shades that have been used for similar applications with successful results, that meet or exceed performance requirements indicated, and of documenting this performance by inclusion in test reports, labels, and calculations. Manufacturer shall have factory-authorized service representatives who are available for consultation, periodic Project-site observations, and on-site assistance.

B. Installer Qualifications: A firm with not less than 5 years' experience installing roller window shades similar in material, design, and extent to that indicated for this Project, whose work has resulted in installations with a record of successful in-service performance, and that employs installers and supervisors who are trained and approved by manufacturer to perform work of this Section.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.9 WARRANTY

A. Special Manufacturer's Warranty: Manufacturer's standard form in which roller shade manufacturer agrees to repair or replace roller shade hardware which fails in material or workmanship within the specified warranty period.

1. Warranty Period for Motorized Roller Shade Hardware: 5 years from date of Substantial Completion.
2. Warranty Period for Shade Cloth: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sustainable Design Requirements: Roller window shade fabric shall comply with the following:

1. Shadeband materials installed in the building interior shall meet the testing and product requirements of the following:

a. Greenguard Indoor Air Quality Certified.

2.2 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the following:

1. Lutron, Inc.

Substitutions or Comparable Products are not permitted, as BOD product is exclusively pre-engineered to work with BOD window shade pockets as specified in Section 095113 "Acoustical Panel Ceilings"

B. Source Limitations: Obtain roller shades and shadeband material from single source from single manufacturer.

2.3 MOTOR-OPERATED, SINGLE-ROLLER SHADES

A. Motorized Operating System: Provide factory-assembled, shade-operator system of size and capacity and with features, characteristics, and accessories suitable for conditions indicated, complete with electric motor and factory-prewired motor controls, power disconnect switch, enclosures protecting controls and operating parts, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with building electrical system.

1. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Electric Motor: Manufacturer's standard tubular, enclosed in roller.

a. Electrical Characteristics: Single phase, 110 V, 60 Hz.

3. Wall Switch Controls: Electric controls with NEMA ICS 6, Type 1 enclosure for recessed or flush mounting. Provide the following for remote-control activation of shades:

a. Individual/Group Control Station: Momentary-contact, three-position, rocker-style, wall-switch-operated control station with open, close, and center off functions for individual and group control.
b. Color: As indicated on Drawings, or if not indicated, as selected by Architect from manufacturer’s full range.
c. Locate switches as indicated on Drawings, or if not indicated, in location as directed by Architect.

4. Crank-Operator Override: Crank and gearbox operate shades in event of power outage or motor failure.
5. Limit Switches: Adjustable switches interlocked with motor controls and set to stop shades automatically at fully raised and fully lowered positions.
6. Operating Features:

a. Group switching with integrated switch control; single faceplate for multiple switch cutouts.
b. Capable of interface with audiovisual control system.
c. Override switch.

B. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

1. Roller Drive-End Location: Right side of inside face of shade Left side of inside face of shade.
2. Direction of Shadeband Roll: Regular, from back of roller.
3. Shadeband-to-Roller Attachment: Manufacturer's standard method.

C. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

D. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers that are operated by one roller drive-end assembly.

E. Installation Accessories:

1. Recessed Shade Pocket: Rectangular, extruded-aluminum enclosure designed for recessed ceiling installation; with front, top, and back formed as one piece, end plates, and removable bottom closure panel.
    a. Height: Manufacturer's standard height required to enclose roller and shadeband when shade is fully open.
    b. Provide pocket with lip at lower edge to support acoustical ceiling panel.
2. Closure Panel and Wall Clip: Removable aluminum panel designed for installation at bottom of site-constructed ceiling recess or pocket and for snap-in attachment to wall clip without fasteners.
    a. Closure-Panel Width: 2 inches.

2.4 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

A. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.

1. Bead Chains: Stainless steel.
    a. Loop Length: Full length of roller shade.
    b. Limit Stops: Provide upper and lower ball stops.
2. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller-shade weight and lifting heavy roller shades.
    a. Provide for shadebands that weigh more than 10 lb or for shades as recommended by manufacturer, whichever criteria are more stringent.

B. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

1. Roller Drive-End Location: Right side of inside face of shade.
2. Direction of Shadeband Roll: Regular, from back of roller.
3. Shadeband-to-Roller Attachment: Manufacturer's standard method.

C. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

D. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.

E. Installation Accessories:

1. Recessed Shade Pocket: Rectangular, extruded-aluminum enclosure designed for recessed ceiling installation; with front, top, and back formed as one piece, end plates, and removable bottom closure panel.

    a. Height: Manufacturer's standard height required to enclose roller and shadeband when shade is fully open.
    b. Provide pocket with lip at lower edge to support acoustical ceiling panel.

2. Closure Panel and Wall Clip: Removable aluminum panel designed for installation at bottom of site-constructed ceiling recess or pocket and for snap-in attachment to wall clip without fasteners.

    a. Closure-Panel Width: 2 inches.

3. Side Channels: With light seals and designed to eliminate light gaps at sides of shades as shades are drawn down. Provide side channels with shadeband guides or other means of aligning shadebands with channels at tops.
4. Bottom (Sill) Channel or Angle: With light seals and designed to eliminate light gaps at bottoms of shades when shades are closed.
5. Installation Accessories Color and Finish: Custom color to match Architect’s sample.

2.5 SHADEBAND MATERIALS

A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.

1. Source: Roller-shade manufacturer.
2. Roll Width: Custom, as indicated on Drawings, or if not indicated, coordinated to align with window mullions.
3. Openness Factor: In accordance with manufacturer’s shadecloth selection guide for visible light transmittance through glass as indicated in Section 088000 “Exterior Glazing.”
4. Basis-of-Design Product:

    a. As indicated on Drawings.

C. Light-Blocking Fabric: Opaque fabric, stain and fade resistant.

1. Source: Roller-shade manufacturer.
2. Type: PVC-free polyester yarns with an opaque acrylic backing.
3. Roll Width: Custom: coordinate with existing window openings.
4. Openness Factor: 0 percent (opaque).
5. Features: Washable.
6. Basis-of-Design Product:

    a. As indicated on Drawings.

2.6 ROLLER-SHADE FABRICATION

A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.

B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:

1. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

C. Shadeband Fabrication: Fabricate shadebands without battens or seams.

PART 3 - EXECUTION

3.1 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 of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER-SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.

B. Electrical Connections: Connect motor-operated roller shades to building electrical system.

3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

A. Clean roller-shade surfaces after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motor-operated roller shades.

END OF SECTION 122413

SECTION 123533.13 - LABORATORY CASEWORK AND FURNISHINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Work required for this section includes laboratory casework with supplementary items necessary to complete their installation.

1. Metal Laboratory Casework.
2. Hardware.
3. Knee Openings.
4. Filler Panels.
5. Service Chase Pipe Support Assembly.
6. Vacuum Pump Cabinets.
7. Movable Tables.
8. Stainless Steel Bench.
9. Finishes.
10. Work surfaces.
11. Sinks.
12. Laboratory Service Fixtures.
13. Emergency Shower and Eye Wash Units
14. Umbilicals.
15. Shelving.
16. Drying Racks.
17. Gas Cylinder Restraints.
18. Snorkel.
19. Sleeves in Countertops.
20. Overhead Service Carriers.
21. Blackout Curtain and Track.

B. Related Requirements:

1. Section 115313 "Laboratory Fume Hoods" for source limitations.
2. Division 22 Section(s): Furnishing and installation of plumbing utilities and final connections to service fixtures.
3. Division 23 Section(s): Furnishing and installation of exhaust ductwork and equipment, and final connection to exhaust devices.
4. Division 26 Section(s): Furnishing and installation of electrical utilities and final connections to casework and accessory equipment.

1.2 COORDINATION

A. Contract Documents Design Intent: Drawings and Specifications indicate design intent for products and systems and do not necessarily indicate or specify total Work required and shall not be construed as an engineered design. Furnish and install all Work required for a complete installation.

B. Coordination of Contract Documents and Work:

1. Product Variations: In the event of minor differences between products and systems of acceptable or available manufacturer/fabricators, Contractor shall notify Architect of such differences and resolve conflicts in a timely manner. Failure of Contractor to provide notification shall be construed as acceptance of conditions indicated, and changes caused by minor differences between products and Contract Documents shall be included in the Work at no additional cost to Owner.
2. Allowable Adjustments: Minor dimension and profile adjustments may be made in interest of fabrication or erection methods or techniques or ability to satisfy design intent, provided design intent is maintained as determined by Architect. Proposed deviations shall include a detailed analysis of impact to adjacent substrates or other building systems, including related design or construction cost impacts. If accepted by Architect, deviations causing changes in materials, constructability, substrates, or conditions shall be included in the Work at no additional cost to Owner.

1.3 REFERENCES

A. Americans with Disabilities Act (ADA).

B. American National Standards Institute (ANSI)

1. ANSI A208.1 – For Particleborad.
2. ANSI A208.2 - For Medium Density Fiberboard.
3. ANSI Z358.1 - Emergency Eyewash and Shower Equipment.
4. ANSI/HPVA HP-1 - For Hardwood and Decorative Plywood.

C. American Society for Testing and Materials (ASTM).

1. ASTM A240 - Chromium and Chromium-nickel Stainless Steel Plate, Sheet, and Strip for pressure Vessels and General Applications.
2. ASTM A366 - Withdrawn, Replaced by ASTM A1008.
3. ASTM A1008 - Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
4. ASTM D570 - Water Absorption of Plastics.
5. ASTM D635 - Rate of Burning and/or Extent and Time of Burning of Plastics in Horizontal Position.
6. ASTM D638 - Tensile Properties of Plastic.
7. ASTM D648 - Deflection Temperature of Plastic Under Flexural Load in the Edgewise Position.
8. ASTM D695 - Compressive Properties of Rigid Plastics.
9. ASTM D790 - Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

D. Architectural Woodwork Institute (AWI).

E. Business and Institutional Furniture Manufacturers Association (BIFMA).

F. Factory Mutual (FM).

G. Forest Stewardship Council (FSC).

H. Leadership in Energy and Environmental Design (LEED II).

I. National Electrical Manufacturers Association (NEMA).

1. NEMA LD3-2000 - High-Pressure Decorative Laminates.

J. National Fire Protection Association (NFPA).

1. NFPA 30 - Flammable and Combustible Liquids Code.
2. NFPA 45 – Standards on Fire Protection for Laboratories Using Chemicals

K. Office of Safety and Health Administration (OSHA).

L. Scientific Equipment and Furniture Association (SEFA).

1. SEFA 8 - Laboratory Furniture Casework, Shelving and Tables Recommended Practices Testing.

M. Underwriters Laboratories (UL).

N. Woodwork Institute (WI).

1.4 ACTION SUBMITTALS

A. Product Data: Submit manufacturer's data for each item of laboratory furnishings and equipment. Include component dimensions, configurations, construction details, joint details, and attachments. Indicate location, size, and service requirement for each utility connection.

B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating that product contains no urea formaldehyde.

C. Shop Drawings:

1. Provide 3/8 inch = 1 foot 0 inches scale minimum elevations of individual and battery of casework units showing cross sections, rough-in and anchor placements, tolerances, and clearances. Indicate relation of units to fume hoods, other laboratory equipment, surrounding walls, windows, doors, and other building components.
2. Provide 1/8 inch = 1 foot 0 inches scale minimum rough-in plan drawings for coordination with trades. Rough-in shall show free area.

D. Samples for Initial Selection: For factory-applied finishes and other materials requiring color selection.

E. Samples for Verification: : Unless otherwise directed, approved full-size Samples may become part of the completed Work, if in an undisturbed condition at time of Substantial Completion. Notify Architect of their exact locations. If not incorporated into the Work, retain acceptable full-size Samples at Project site and remove when directed by Architect.

1. Top Samples: Submit product sample of each type of benchtop.
2. Hardware Samples: Provide samples of door and drawer pulls, locks, casters, and hinges.
3. Finish Samples: Submit 3 inch by 5 inch samples of each color of finish for casework, work surfaces and for other prefinished equipment and accessories for selection by the Owner's Representative.
4. Cabinet Samples: Submit the following full size cabinet samples constructed as specified herein. Ship to the lab consultant for review and approval before fabrication of casework and after approval of cabinet hardware and finish sample submittals.
   a. Cabinet Types:

      1) MOBILE BASE CABINET.
      2) C36 BASE CABINET.
      3) D36 BASE CABINET.

1.5 INFORMATION SUBMITTALS

A. Qualification Data: For manufacturer and installer.

1. For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of Architects and Owners, and other information specified.
2. Architect may waive submittal of qualification data for available manufacturers listed in this Section.

B. Product Test Reports: Submit test reports verifying conformance to specified performance tests.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish complete touchup kit for each type and color of metal laboratory casework provided. Include fillers, primers, paints, and other materials necessary to perform permanent repairs to damaged laboratory casework finish.

B. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Cabinet Mounting Clips and Related Hardware: Quantity equal to 5 percent of amount installed, but no fewer than 20 of each type.

2. Modular Countertop Units: Two extra units of each length and material installed.

1.7 QUALITY ASSURANCE

A. Manufacturer/Fabricator Qualifications: Manufacturer/fabricator with not less than 10 years experience with successful production of products and systems similar to scope of this Project, with a record of successful in-service performance and completion of projects for a period of not less than 10 years, and with sufficient production capability, facilities, and personnel to produce required Work.

1. Modern plant with proper tools, dies, fixtures, and skilled production staff to produce high quality laboratory casework and equipment, and shall meet the following minimum requirements:

a. 10 years or more experience in manufacture of laboratory casework and equipment of type specified.
b. 10 installations of equal or larger size and requirements.

B. Installer Qualifications:

1. Experience: Installer with not less than 10 years experience in performing specified Work similar to scope of this Project, with a record of successful in-service performance and completion of projects for a period of not less than 10 years, and with sufficient production capability, facilities, and personnel to produce required Work.
2. Supervision: Installer shall maintain a competent supervisor who is at Project during times specified Work is in progress, and, who is experienced in installing systems similar to type and scope required for Project.
3. Manufacturer/Fabricator Acceptance: Installer shall be certified, approved, licensed, or acceptable to manufacturer/fabricator to install products.

C. Manufacturer's Technical Representative Qualifications: Direct employee of technical services department of manufacturer with minimum of 10 years experience in providing recommendations, observations, evaluations, and problem diagnostics. Sales representatives are not acceptable.

1.8 PRE-INSTALLATION CONFERENCE

A. Pre-Installation Conference: Before Work begins, conduct conference at Project site to comply with requirements of applicable Division 01 Sections.

1. Required Attendees:

a. Owner.
b. Architect.
c. Contractor, including superintendent.
d. Installer, including project manager and supervisor.
e. Manufacturer/fabricator's qualified technical representative.
f. Installers of other construction interfaced with Work.

2. Minimum Agenda: Installer shall demonstrate understanding of the Work required by describing detailed procedures for preparing, installing, and cleaning the Work. Demonstration shall include, but not be limited to, following topics:

a. Tour representative areas of Work, inspect and discuss condition of substrate, and other preparatory work performed by other trades.
b. Review Work requirements (Drawings, Specifications, and other Contract Documents).
c. Review required submittals, both completed and yet to be completed.
d. Review and finalize construction schedule related to Work and verify availability of materials, installer's personnel, equipment, and facilities needed to make progress and avoid delays.
e. Review required inspection, testing, certifying, and material usage accounting procedures.
f. Review environmental conditions and procedures for coping with unfavorable conditions.
g. Resolve deviations or differences between Contract Documents and the manufacturer/fabricator's specifications.

3. Contractor shall record discussions of conference, including decisions and agreements reached, and furnish copy of record to each party attending. If substantial disagreements exist at conclusion of conference, determine how disagreements will be resolved and set date for reconvening conference.

1.9 MOCK-UP

A. Provide a mock-up of A type bench, B type bench, C type bench and SC24 (supply cart).

1. Construct mock-up in accordance with the construction documents, including drawings and specifications using exact materials and methods, including required accessories such as electrical.
2. Mock-ups shall be complete in all respects and shall represent the final complete units.
3. Review mock-ups with the owner, owner representative, general contractor and design team.
4. Where review of mock-ups may require revisions, such revisions will be provided in writing to the general contractor and sub-contractors.

1.10 DEVIATIONS

A. Provide written notice of proposed deviations in as much detail as possible at the earliest time.

1. Do not proceed with proposed deviations until expressly approved in writing.
2. All verbal conversations regarding deviations are to be summarized in writing and submitted to the owner, owner representative, general contractor and design team.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Schedule delivery of casework and equipment so that spaces are sufficiently complete that material can be installed immediately following delivery.

B. Handling: Protect finished surfaces from soiling or damage during handling and installation. Keep covered with polyethylene film or other protective coating. Protect all work surfaces from damage throughout construction period. Do not allow standing on work surfaces during the construction period. Provide signage marked in large lettering that reads: “NO STANDING”.

1.12 PROJECT CONDITIONS

A. Do not deliver or install equipment until the following conditions have been met:

1. Building areas requiring the installation of laboratory casework: Dry and unexposed to adverse weather conditions which may damage finished materials.
2. The air conditioning or heating system: On and functioning in areas of casework installation to maintain the temperature between 60 and 85 degrees Fahrenheit with the relative humidity between 45 percent and 65 percent.

B. Field Measurements: Where products and systems are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.13 SEQUENCING AND SCHEDULING

A. All overhead mechanical, electrical and plumbing rough-in work: Complete prior to laboratory casework deliveries.

B. All mechanical, electrical and plumbing rough-in work required along walls and service islands, where lab furnishings are to be installed: Complete prior to delivery of materials.

C. Walls and partitions must be in place and finished with at least the primer coat of paint. If finish painting is to take place after lab casework and furnishings installation, protect the casework and furnishings by covering and masking prior to commencement.

D. All necessary wood or metal blocking must be installed within partitions prior to delivery of casework and furnishings.

E. Overhead soffits and ceiling grid must be in place prior to casework installation.

F. Overhead lighting must be installed and connected prior to casework installation.

G. All flooring required to be placed under lab casework and furnishings must be installed prior to material delivery.

H. Concrete floors must be level within 1/8 inch of level per 10 foot run, noncumulative, when tested with a straight edge in any one direction.

I. Wet operations to be performed must be complete prior to material deliveries.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

A. Manufacturers/Fabricators and Products: Subject to compliance with requirements, provide laboratory casework and furnishings by one of the following:

1. Wesinco, Inc.
2. Dow Diversified
3. Hansen
4. Jamestown Metal Products Inc.
3. Kewaunee Scientific Corporation
4. Mott Manufacturing Limited.

B. Source Limitations: Obtain the following from single source from single manufacturer:

1. Laboratory casework, work surfaces, laboratory furnishings, and accessories.
2. Laboratory fume hoods.

2.2 CASEWORK DESIGN: METAL

A. Flush Overlay Construction: Overlay case body with door and drawer fronts.

B. Self-Supporting Units: Completely welded shell assembly without applied panels at ends, backs or bottoms, so that cases can be used interchangeably or as a single, stand-alone unit.

C. Interior of Case Units: Easily cleanable, flush interior. Base cabinets, 30 inches and wider, with double swinging doors shall provide full access to complete interior without center vertical post.

D. Drawers: Sized on a modular basis for interchange to meet varying storage needs, and designed to be easily removable in field without the use of special tools.

E. Case Openings: Rabbeted-like joints all 4 sides of case opening for hinged doors and 2 sides for sliding doors in order to provide dust resistant case.

F. Secure intersection of case members with spot and arc welds.

G. Testing of Casework, Tables, and Shelving: Meet or exceed SEFA 8 M "Laboratory Grade Metal Casework."

2.3 MATERIALS

A. Sheet Steel:

1. ASTM A1008 mild steel, cold-rolled, pickled, double annealed, and free from rust, scales, deep scratches, buckles, ragged edges, and other defects. Provide metallic furniture stock sheets.

B. Stainless Steel:

1. Type: Unless otherwise noted on Drawings or elsewhere in this Section, provide Type 304; ASTM Specification Number A240; stainless steel for tops, sinks, umbilical collar, shelves, and casework; gage as indicated on Drawings.
2. Finish: Exposed surfaces ground and polished to a Number 4 satin finish. Provide Type 304 with a tumbled finish approximating a Number 4 finish for nuts, screws, bolts, and rivets. Provide the grain finish direction as follows:

    a. Vertical on door and drawer fronts
    b. Vertical on tall storage cabinets door fronts and end panels.
    c. Horizontal on all other exterior surfaces.

3. Welding: Provide all stainless steel welding material of type similar to sheet material. Provide welds made without discoloration; ground, polished, and passivated to blend harmoniously with a Number 4 satin finish.

C. Plastic Laminate:

1. Grade VGP: For horizontal surfaces. High pressure decorative laminate, laboratory grade, chemically resistant, meeting or exceeding NEMA Standard LD 3-2000 Grade VGP. Low glare, finely ground textured finish with gloss reading of 12.
2. Grade VGS: For vertical surfaces. High pressure decorative laminate, finely ground textured finish, meeting or exceeding NEMA Standard LD 3-2000, Grade VGS.
3. Grade BKL: Backing sheets. High pressure phenolic meeting or exceeding NEMA Standard LD 3-2000, Grade BKL.
4. Grade VGL: Cabinet liner. Thermo fused melamine resin, polyester thermo fused or a melamine impregnated foil with an acid catalyzed lacquer finish, laminated to a sanded core material under pressure and heat. Finely ground textured finish. Liner shall meet or exceed NEMA Standard LD 3-2000, Grade VGL.
5. Grade CLS: High pressure cabinet liner. High pressure decorative laminate, finely ground textured finish, meeting or exceeding NEMA Standard LD 3-2000 Grade CLS.
6. Core Material: Particleboard.
7. Edgebanding: High grade PVC edging applied, under heat and pressure, by edge banding machine with hot melt waterproof adhesive of same color as edging. Trim and buff smooth with all edges and corners radiused.

D. Epoxy Resin Sheets:

1. Molded from modified epoxy resin that has been compounded and cured to provide optimum physical and chemical resistance required of a heavy duty laboratory working surface. Uniform mixture throughout, not dependent on a surface coating.
2. Physical Properties:

    a. Compressive Strength (ASTM D695): 30,600 psi.
    b. Flexural Strength (ASTM D790): 12,800 psi.
    c. Tensile Strength (ASTM D638): 10,100 psi.
    d. Heat Distortion (ASTM D648): 330 degrees Fahrenheit.
    e. Water Absorption (ASTM D570): 0.018 percent.
    f. Fire Resistance (ASTM D635): Self Extinguishing.

E. Glass:

1. Laminated safety glass: Two outer plies of glass with a vinyl interlayer, nominal 1/4 inch thick.
2. Tempered safety glass: Heat treated glass, nominal 1/8 inch thick with a minimum of 88 percent clarity.

F. Polycarbonate Resin Sheets: Lexan as manufactured by General Electric Corporation, or Tuffak as manufactured by Rohm and Haas Company, 1920 Tubeway Avenue, Los Angeles, California. Clear 1/4 inch thick unless otherwise noted. Provide sheets free of warp and distortion.

G. Polypropylene: Provide 1/4 inch thick sheets unless otherwise noted, smooth, free of surface blemishes with all edges rounded to 1/8 inch radius; low flame spread and low smoke generating type.

2.4 CASEWORK FABRICATION: METAL

A. Floor Mounted Base Cabinets

1. End Panels and Backs

a. 18 gage steel.
b. End panels and back formed from a single steel sheet with front edges formed to a channel shape and further offset to form a strike for doors and drawers.
c. Reinforce at front and rear corners with 18 gage full upright posts containing shelf adjustment holes, maximum 1/2 inch on centers.
d. Provide removable backs on all base cabinets, except units with security panels and sink cabinets, to allow access to service piping from the front of the unit
e. All sink cabinets to have partial height back panels to allow passage of drain line and piping to service chase.

2. Bottoms:

a. 18 gage steel.
b. Bottom and bottom rail formed from a single piece of metal with both sides and back formed up with a radius between flange and bottom for ease of cleaning. Form front rail to provide a strike for doors and drawers.
c. Reinforce at front corners with 14 gage gusset.

3. Front Top Rails:

a. 16 gage steel.
b. Provide flush at face of cabinet and interlock within the flange at the top of the end panels. Form front of rail to provide a strike for doors and drawers.
c. Reinforce at front corners with 14 gage gusset.

4. Toe space Rails:

a. 18 gage steel.
b. Install between end panels to provide a minimum toe space of 3 inches deep by 4 inches high.
c. Provide 11 gage steel corner gussets at front and rear corners with 3/8 inch diameter leveling screws integral with bottom flange.

5. Intermediate Rails:

a. Provide between drawers and doors and between drawers at all security panels.
b. Recessed behind doors and drawer fronts.
c. Removable for later revision in cabinet configuration.

6. Security Panels:

a. 18 gage steel.
b. Provide on all base cabinets with locks, between drawers and door, and between drawers.

7. Adjustable Pullout Shelves:

a. 20 gage steel.
b. Form in one-piece including the bottom, two sides, front, and back.
c. Sides, front, and back to be 2 inches high with return bends to eliminate sharp edges.
d. Adjustable on 1/2 inch centers.
e. Front edge of shelf to be within 1 inch of inside face of door.
f. Pullout shelves to fully extend with doors open at minimum of 90 degrees.

8. Adjustable Shelves:

    a. 20 gage steel.
    b. Form front and back edges down 3/4 inch and returned back 3/4 inch. Form ends down 3/4 inch.
    c. For shelves over 36 inches long or 16 inches deep, reinforce with a welded hat channel for the full length of the shelf.
    d. Adjustable on 1/2 inch centers.
    e. Front edge of shelf to be within 1 inch of inside face of door.

9. Hinged Doors:

    a. 3/4 inch double wall assembly with 18 gage exterior panel and 20 gage interior panel.
    b. Reinforce interior of front panel with welded steel hat channels. Prepaint and sound deaden interior. Weld outer corners and grind smooth.
    c. Secure hinges with screws to internal 14 gage reinforcing in case and door. Hinges shall be removable; welding of hinges is not acceptable.
    d. Doors shall close against rubber bumpers.

10. Drawers:

    a. Drawer front: 3/4 inch double wall assembly, 20 gage interior and exterior panels, prepaint prior to assembly and sound deaden, weld top front corners and grind smooth.
    b. Drawer body: 20 gage steel, one-piece construction including bottom, 2 sides, back, and inner front. Fully coved at interior bottom.
    c. Drawers shall close against rubber bumpers.
    d. Provide security panels for drawers with keyed different locks.

B. Mobile Cabinets:

1. Provide mobile cabinets as described under Floor Mounted Base Cabinets above, unless modified under this Article.
    a. Omit toe space rail or bottom base.
    b. Anti-Tip Interlock: Provide in all cabinets with drawers and adjustable pullout shelves. Provide with snapper actuator, lockbar, adjustable locking pins, drawer wedges, lockbar retainers, and wedge lock.

        1) Basis of Design: Compx Timberline, System 350

C. Wall and Upper Cabinets:

1. End Panels and Backs

    a. 18 gage steel.
    b. End panels and back formed from a single steel sheet with front edges formed to a channel shape and further offset to form a strike for doors and drawers.
    c. Reinforce at front and rear corners with 18 gage full upright posts containing shelf adjustment holes, maximum 1/2 inch on centers.

2. Bottoms:

    a. 18 gage steel.
    b. Bottom and bottom rail formed from a single piece of metal with both sides and back formed up with a radius between flange and bottom for ease of cleaning.
    c. Form front rail to provide a strike for doors and drawers.
    d. Reinforce at front corners with 14 gage gusset.

3. Tops

    a. 18 gage steel.

b. One piece construction with front edge formed into a channel shape and offset for door recess and to provide a strike for doors. Turn down flanges at back and side edges for welding top to back and end panels.
c. Reinforce at front corners with 14 gage gusset.

4. Adjustable Shelves:

a. 20 gage steel.
b. Form front and back edges down 3/4 inch and returned back 3/4 inch. Form ends down 3/4 inch.
c. For shelves over 36 inches long or 16 inches deep, reinforce with a welded hat channel for the full length of the shelf.
d. Adjustable on 1/2 inch centers.
e. Front edge of shelf to be within 1 inch of inside face of door.

5. Hinged Solid Doors:

a. 3/4 inch double wall assembly with 18 gage exterior panel and 20 gage interior panel.
b. Reinforce interior of front panel with welded steel hat channels. Prepaint and sound deaden interior. Weld outer corners and grind smooth.
c. Secure hinges with screws to internal 14 gage reinforcing in case and door. Hinges shall be removable; welding of hinges is not acceptable.
d. Doors shall close against rubber bumpers.

6. Hinged Framed Glass Doors:

a. Frame: Outer head of 18 gage one piece construction. Inner head consisting of top, bottom and side framing members removable for replacement of glass.
b. Glass: tempered safety glass.
c. Provide continuous vinyl glazing retainer to receive glass.

7. Unframed Sliding Glass Doors:

a. Glass: laminated safety glass with exposed edges ground.
b. Set in extruded aluminum shoe with integral pulls, nylon wheel assemblies, and top and bottom extruded aluminum track.
c. Provide rubber bumpers at fully opened and closed door position and space guides fitting into top track.

8. Framed Sliding Glass Doors:

a. Frame: Outer head of 18 gage one piece construction. Inner head consisting of top, bottom and side framing members removable for replacement of glass.
b. Glass: tempered safety glass.
c. Track assembly: Overhead aluminum track with adjustable nylon roller hangers and bottom aluminum channels with 2 plastic guides per door. Provide valance in front of track assembly.
d. Provide extruded vinyl retaining molding to receive glass.

9. Sliding Solid Doors:

a. 3/4 inch double wall assembly with 18 gage exterior panel and 20 gage interior panel.
b. Reinforce interior of front panel with welded steel hat channels. Prepaint and sound deaden interior. Weld outer corners and grind smooth.
c. Track assembly: Overhead aluminum track with adjustable nylon roller hangers and bottom aluminum channels with 2 plastic guides per door. Provide valance in front of track assembly.

D. Tall Cabinets:

1. End Panels and Backs

   a. 18 gage steel.
   b. End panels and back formed from a single steel sheet with front edges formed to a channel shape and further offset to form a strike for doors and drawers.
   c. Reinforce at front and rear corners with 18 gage full upright posts containing shelf adjustment holes, maximum 1/2 inch on centers.

2. Bottoms:

   a. 18 gage steel.
   b. Bottom and bottom rail formed from a single piece of metal with both sides and back formed up with a radius between flange and bottom for ease of cleaning. Form front rail to provide a strike for doors and a 4 inch high base.
   c. Reinforce at front corners with 14 gage gusset.

3. Tops

   a. 18 gage steel.
   b. One piece construction with front edge formed into a channel shape and offset for door recess and to provide a strike for doors. Turn down flanges at back and side edges for welding top to back and end panels.
   c. Reinforce at front corners with 14 gage gusset.

4. Fixed and Adjustable Shelves:

   a. 20 gage steel.
   b. Form front and back edges down 3/4 inch and returned back 3/4 inch. Form ends down 3/4 inch.
   c. For shelves over 36 inches long or 16 inches deep, reinforce with a welded hat channel for the full length of the shelf.
   d. Center shelf to be fixed by attaching to end panels with screws.
   e. Adjustable on 1/2 inch centers.
   f. Front edge of shelf to be within 1 inch of inside face of door.

5. Hinged Doors:

   a. 3/4 inch double wall assembly with 18 gage exterior panel and 20 gage interior panel.
   b. Reinforce interior of front panel with welded steel hat channels. Prepaint and sound deaden interior. Weld outer corners and grind smooth.
   c. Secure hinges with screws to internal 14 gage reinforcing in case and door. Hinges shall be removable; welding of hinges is not acceptable.
   d. Doors shall close against rubber bumpers.

6. Hinged Framed Glass Doors:

   a. Frame: Outer head of 18 gage one piece construction. Inner head consisting of top, bottom and side framing members removable for replacement of glass.
   b. Glass: laminated safety glass.
   c. Provide continuous vinyl glazing retainer to receive glass.

7. Framed Sliding Glass Doors:

   a. Frame: Outer head of 18 gage one piece construction. Inner head consisting of top, bottom and side framing members removable for replacement of glass.
   b. Glass: laminated safety glass.
   c. Track assembly: Overhead aluminum track with adjustable nylon roller hangers and bottom aluminum channels with 2 plastic guides per door. Provide valance in front of track assembly.
   d. Provide extruded vinyl retaining molding to receive glass.

8. Sliding Solid Doors:

   a. 3/4 inch double wall assembly with 18 gage exterior panel and 20 gage interior panel.
   b. Reinforce interior of front panel with welded steel hat channels. Prepaint and sound deaden interior. Weld outer corners and grind smooth.
   c. Track assembly: Overhead aluminum track with adjustable nylon roller hangers and bottom aluminum channels with 2 plastic guides per door. Provide valance in front of track assembly.

2.5 HARDWARE:

A. Drawer and Hinged Door Pulls: 3/8 inch diameter stainless steel wire pull, 4-3/4 to 5-1/16 inches center to center with radiused corners and a projection of 1 inch to 1-1/2 inches. Model 115.61.602 as manufactured by Hafele America (800) 423-3831, Lamp Model SST-30L as manufactured by Sugatsune America, Inc. (800) 562-5267, Model 1.381.128 as manufactured by Ironmonger Inc. (800) 621-1937, or Model DP57C as manufactured by Mockett (800) 523-1269.

   1. Provide with a clear abrasion and acid resistant coated finish.
   2. Mount door pulls vertically and drawer pulls horizontally.
   3. Provide drawers 48 inches wide and smaller with one pull per drawer face at centerline of cabinet.

B. Drawer and Pullout Shelving Slides:

   1. Description: Full extension, ball bearing, rail mounted, multimembered slides fabricated of minimum 16 gage steel with an electro-zinc finish.
   2. Available Manufacturers:

      a. Accuride International Incorporated, Santa Fe Springs, California
      b. CompX Precision Slides, Waterloo, Ontario Canada
      c. Knape and Vogt, Grand Rapids, Michigan

   3. Drawer Slides: Basis of Design as follows

      a. Drawer Width: 0-24 inches Accuride 3820 (Metal) Maximum dynamic load rating 100 pounds
      b. Drawer Width: Over 24 inches Accuride 3620 (Metal) Maximum dynamic load rating 200 pounds

   4. Pullout Shelving Slides: Basis of Design as follows:

      a. Shelving Width: 0-24 inches Accuride 3820 (Metal) Maximum dynamic load rating 100 pounds
      b. Shelving Width: Over 24 inches Accuride 3620 (Metal) Maximum dynamic load rating 200 pounds

   5. Slides shall have progressive movement with a positive stop at full extension or at a minimum 1 inch over travel and permit removal of drawer without use of tools. Drawers shall not lift out or otherwise be removable without the release of a locking device on each slide.
   6. Dynamic Load Rating: Slides meet BIFMA "Business Institutional Furniture Manufacturers Association" Standards. 0.017 pounds per cubic inch at full travel plus or minus 1/4 inch for 50,000 cycles.

C. Pull-out Shelf Bumper: Provide on hinged side of pull-out shelf.

   1. Basis of Design: Bainbridge Manufacturing, Inc., Part Number 1934.

D. Hinges:

   1. Description: Institutional type, 5-knuckle, wraparound design, projecting barrel, minimum 2-1/2 inches long.

2. Material: Type 304 stainless steel, minimum 0.095 inches thick.
3. Provide minimum of 2 hinges for doors under 48 inches high; minimum of 3 hinges for doors 48 inches to 84 inches high; and minimum of 4 hinges for doors over 84 inches in height.
4. Mounting: Wing for mounting to end panels shall have 4 holes, two of which are slotted for adjustability. Wing for door shall have 2 holes for mounting to the edge of the door and 3 holes for mounting to the inside face of the door, two of which are slotted for adjustability. Use stainless steel screws.

E. Door Catches: Roller type, adjustable, operating with a built-in tension spring. Provide all parts of cadmium plated steel except roller. Attach to top of base cabinet doors, the bottom of wall cabinet doors, and at the top and bottom of tall cabinet right-hand doors. Provide an elbow catch for the left-hand door of tall cabinets at the fixed center shelf.

F. Shelf clips: Die formed zinc plated steel pin and socket type or plastic twin-pin type. Provide shelf clips adjustable on 1-1/4 inch centers and meet seismic requirements.

G. Locks:

1. Provide with base and wall cabinets as shown on the Drawings.
2. Provide with all tall cabinets.
3. Description: 5-pin tumbler, heavy duty cylinder cam lock type.
4. Acceptable Manufacturers:

    a. CompX National, Greenville, South Carolina
    b. Corbin, Berlin, Connecticut
    c. Best Lock Corporation, Indianapolis, Indiana
    d. Illinois Lock Company, Wheeling, Illinois

5. Finish: Exposed surfaces of locks shall match other casework hardware.
6. Keying: Capacity for 2000 primary key changes. Master key 1 level with built-in flexibility to accommodate, if required, 3 levels; 1 Grandmaster, 59 Master groups and 70 Submaster groups with 13 primary changes under each.
7. Keys: Stamped brass available from manufacturer or local locksmith, and supplied in the following quantities unless otherwise specified:

    a. 2 for each keyed different lock.
    b. 3 for each group keyed alike locks.
    c. 2 for master keys for each system.

H. Leveling Glides: 2 inch diameter, two-piece pivot construction, steel housing, non-marring, phenolic or translucent plastic insert, 1/2 inch diameter, minimum 1-1/2 inch long zinc plated stems.

I. Casters: Swivel type, 4 inch overall height, with wheel lock. Provide minimum load rating of 300 pounds.

1. Basis of Design: Payson Model 050-3UM WK.

J. Anti-Tip Interlock: Provide in all mobile cabinets with drawers and adjustable pullout shelves. Provide with snapper actuator, lockbar, adjustable locking pins, drawer wedges, lockbar retainers, and wedge lock.

1. Basis of Design: Compx Timberline, System 350.

2.6 KNEE OPENING (KO):

A. Components:

1. Perimeter Rails: 3/4 inch by 4-1/8 inches C-channel.
2. Reinforcing Cross Rails: 3/4 inch by 4-1/8 inches steel C-channel at intervals not more than 33 inches on centers.
3. Leg: 2 inch by 2 inch steel tube legs with welded leg bracket. Attach legs with 2 bolts to front and back aprons and weld to end rails. Provide legs with leveling glides and a 2 inch high black coved vinyl or rubber shoe around leg base.
4. End Panel: 3/4 inch thick support end panel.
5. Back Panel: Minimum 18 gage steel. Provide all panels with bottom 6 inches fixed and the top portion removable

6. Drawers. Provide as noted on the Drawings. Drawer unit, hardware, and suspension same as specified for base unit drawers.

B. Construction:
1. 30 inches Minimum KO opening width, unless otherwise noted.
2. For spans 72 inches or more, provide an intermediate leg support.
3. For KO's between two cabinets or cabinet and wall, provide front and back perimeter rails. Provide reinforcing cross rail as required. Attach with steel angles to adjacent cabinets or wall.
4. For KO's at the end of a bench, provide front, back, and side perimeter rails. Provide reinforcing cross rails as required. Attach with steel angles to cabinets and steel corner braces, grooved and screwed into both rails at each corner.
5. For KO benches with no adjacent cabinets or walls, provide front, back, and side perimeter rails. Provide reinforcing cross rails as required. Attach with steel corner braces, grooved and screwed into both rails at each corner.

2.7 FILLER PANELS:

A. Provide filler panels and service chase enclosure panels at exposed to view areas between back of cabinets and walls, between backs of cabinets at end of island or peninsula benches, and at any other area necessary to enclose gaps. Provide all filler panels with bottom 6 inches fixed and the top portion removable.

B. Materials:

1. Minimum 18 gage steel.
2. Grind edges and radius corners to eliminate sharp edges..

C. Secure to frame and/or cabinet back and wall with metal angle and oval head screws with finishing washers.

2.8 SERVICE CHASE PIPE SUPPORT ASSEMBLY:

A. Provide in all service chases whether or not piping is required.

B. Channels: Provide assemblies as detailed on the Drawing. Unistrut part numbers are referenced.

1. Acceptable Manufacturers and Products:

a. Unistrut Corporation
b. Elcen
c. Grinnell Power Strut

C. Space and position pipe support assemblies out of all knee opening and undercounter equipment locations.

2.9 VACUUM PUMP CABINETS

A. Construction: Construct as specified for metal laboratory casework and as detailed on drawings.

B. Vacuum Pump and Cabinet Exhaust: Provide a 2 inch polypropylene exhaust pipe from inside cabinet to 6 inches above ceiling as details on the Drawings. Secure vent pipe inlets to back of cabinet with polypropylene locking nuts.

C. Doors: Provide air gap between back of door and toe kick panel.

D. Interior: Provide acoustical insulation on all sides, back, top, and doors.

E. Pull-out Shelf on Casters: Provide with a removable 18 gage minimum galvanized metal pan, full depth and width of cabinet, with a 1 inch lip all around, and four swivel type casters. Mount toe kick panel to front edge of shelf.

F. Vacuum Line Pass-Through: Provide a 1 inch hole in back of cabinet for the vacuum piping provided by Division 15. Final connection to O.F.O.I. pumps by owner.

G. Electrical: Factory install switch, receptacle, wiring, and all required electrical fittings in accordance with applicable codes and Division 16 specifications. Final connection to back of cabinet by electrical contractor.

H. Finish: Color selected by Owner's Representative.

2.10 ADJUSTABLE HEIGHT MOVABLE T-FRAME TABLE:

A. Upper horizontal rails: 2 inches by 2 inches by 12 gage steel channel with a continuous inner reinforcement U-channel. Spot weld inner reinforcement channel approximately 12 inches on center, staggering weld on each side. Attach to leg assembly with a 1-1/2 inch by 4 inch by 1/4 inch thick steel mounting angle using connecting bolts. Provide removable end closure caps at all exposed ends.

B. Stretcher: Premium grade 1-1/2 inches by 3/4 inch steel spreader. Attach to leg assembly with a 1-1/2 inches by 1-1/2 inch by 1/4 inch thick steel mounting angle using connecting bolts.

C. Connecting bolts: Minimum 3/8 inch diameter commercially cadmium plated or stainless steel bolts, nuts and washers, as protection against corrosion.

D. Adjustable Telescoping Leg Assembly:

1. Upper and lower horizontal leg members of 3 inches by 2 inches by 12 gage thick steel tubing.
2. Vertical leg members consist of outer tube 2 inches by 2 inches by 12 gage thick steel channel with inner tube 1-1/2 inches by 1-1/2 inches by 12 gage. Weld outer tubes to upper horizontal leg member and inner tubes to lower horizontal leg member at each end of table.
3. Provide 9/16 inch diameter holes drilled 2 inches on center in vertical leg members. Provide 1/2 inch diameter by 2-1/2 inch useable leg stainless steel push-button, quick-release pins, McMaster-Carr model 92384A096, or equal.
4. Provide each leg with a leveling glide, unless otherwise noted.

E. Assemble table by bolting leg assemblies to upper horizontal rails and to stretcher; as detailed on the Drawings.

F. Finish: Finish as specified for Metal Finishes under this section. Color selected by the Owner's Representative.

G. Top: As specified for Work Surfaces under this section. Refer to Drawings for material.

2.11 FINISHES

A. Metal Finishes:

1. Finish casework, casework support structure and other laboratory furnishings.
2. Preparation: Spray clean metal with a heated cleaner / phosphate solution, pretreat with iron phosphate spray, water rinse, and neutral final seal. Immediately dry in heated ovens, gradually cooled, prior to application of finish.
3. Application: Electrostatically applied epoxy or urethane powder coat painting process that coats all hidden and exposed surfaces with an acid and abrasion resistant coating. Bake in a controlled high temperature oven to ensure a smooth, hard satin finish. Surfaces shall have a chemical resistant, high grade laboratory furniture quality finish of the following thicknesses:

    a. Exterior and interior surfaces exposed to view: 1.5 mil average and 1.2 mil minimum.
    b. Backs of cabinets and other surfaces not exposed to view: 1.0 mil average.
    c. Finish drawer bodies in matching or harmonizing color and apply corrosion resistant treatment to selected, concealed interior parts.

4. Color: Selection by the Owner's Representative from non standard colors.
5. Metal Finish Performance Requirements:

a. Abrasion Resistance: Maximum weight loss of 5.5 mg per 100 cycle when tested on a Taber Abrasion Tester Number E40101 with 1000 gm wheel pressure and Calibrase Number CS10 wheel.
b. Hardness: Surface hardness equivalent to 4H or 5H pencil.
c. Humidity Resistance: Withstand 1,000 hour exposure in saturated humidity at 100 degrees Fahrenheit.
d. Moisture Resistance: No visible effect to surface finish after boiling water trickled over test panel inclined at 45 degrees Fahrenheit for 5 minutes. No visible effect to surface finish following 100 hour continuous application of a water soaked cellulose sponge, maintained in a wet condition throughout the test period.
e. Adhesion: Score finish surface of test panel with razor blade into 100 squares, 1/16 inch by 1/16 inch, cutting completely through the finish but with minimum penetration of the substrate, and brush away particles with soft brush. Minimum 95 squares shall maintain their finish.
f. Salt Spray: Withstand minimum 200 hour salt spray test, conforming to ASTM B117-59 procedure.

2.12 WORK SURFACES

A. Solid Phenolic Resin:

1. Manufacturers:

a. Trespa North America, TOPLAB PLUS
b. Approved equal

1. Thickness: Material shall have uniform thickness (+0.03 inch (0.76 mm)) and flatness (maximum difference of 0.03 inch (0.76 mm)) for 10 foot (3 m) span.
a. Work surface: 1 inch (25 mm).
b. Fume hood work surfaces: Tops shall be 1¼ (32 mm) inches thick at outer edge, indented ¼ inch (6 mm) to provide a raised rim around all exposed edges 1 inch (25 mm) wide, minimum, or as to allow for the fume hood sash. The front top edge of the raised rim and exposed vertical corners of the top shall be rounded or chamfered to a 1/8 inch (3 mm) radius. The juncture between the raised rim and the top surface shall be coved or chamfered to a ¼ inch (6 mm) radius.
c. Curbs and Splashes: ¾ inch (19 mm).

2. Color
a. Black
b. Color to be selected by the architect
c. Color sample to be approved by Architect prior to fabrication.

3. Description:
a. Drip Grooves: Provided under all work surface exposed edges, unless noted otherwise on the Laboratory Furnishing Drawings. Drip grooves shall be ½ inch (13 mm) from the front edge where the top overhangs 1 inch (25 mm) and ¼ inch (6 mm) from the edge where the edge overhangs ½ inch (13 mm).
b. Edge Profile: All exposed edges shall be sanded to a smooth finish and rounded to a ¼ inch (6 mm) radius at front top edge and at vertical corners, except as indicated
c. Marine edges: Where indicated on the Laboratory Furnishing Drawings, shall be formed by adding ¼ inch thick x 1 inch x 1 inch (6 x 25 x 25 mm) solid phenolic angle strips to the top of the work surface perimeter using an epoxy or clear silicone sealant, unless otherwise indicated on the Laboratory Furnishing drawings. Edges adjoining the open work surface area shall be splayed at an angle of 45°.
d. Provide all holes and cutouts as required for built-in equipment and mechanical and electrical service fixtures. Verify size of opening with actual size of equipment to be used prior to making openings. Form inside corners to a radius of not less than 1/8 inch (3 mm). After sawing, rout and file cutouts to ensure smooth, crack-free edges.

4. Sink Mounting:

a. Cutouts for drop-in sinks shall be routed to form openings with 3/8 inch (10 mm) minimum depth supporting flanges and such that the rims of the installed sinks are 1/8 inch (3 mm) below the surrounding work surface level or bottom of drain grooves, if present. The top edge of the cutout shall have 1/8 inch (3 mm) bevel. Epoxy sinks shall be set in beds of epoxy adhesive. Stainless steel and polypropylene sinks shall be set in beds of clear silicone sealant.
b. Curbs and Splashes:
c. Height: 4 inches (100 mm), unless noted otherwise on Laboratory Furnishing Drawings.
d. Bonded to the surface of the top to form a square joint. Joints between sections of curb shall be stepped or mitered as necessary to minimize the amount of black core exposed.
e. Fix work surface panels with blind fastenings into the back or underside of the panel. Use #10, type A sheet metal screws sized to stop at least 1/8 inch (3 mm) short of the finished face. Pre-drill panel with an 11/64 inch (4.4 mm) diameter high-speed drill bit aligned with 7/32 inch (5.6 mm) clearance holes in the supporting structure.
f. Form tight-fitting butt joints in the work surface using mechanical fasteners positioned to be concealed after installation.
g. Form seams in the work surface with butt joints with silicone adhesive sealant, nominally 1/8 inch (3 mm) wide.

5. Physical Properties:
   a. Modulus of elasticity: 1.5 x 106 psi (10.3 GPa) minimum.
   b. Shear strength: 2000 psi (14 MPa) minimum.
   c. Compressive strength: 24000 psi (165 MPa) minimum.
   d. Weight: 93 lb/ft3 (1490 kg/m³) maximum.

6. Acid Resistant (Toplab).
   a. Bunsen burner test: 30 seconds; no visible effect.

7. Non-porous surface and edges.
   a. Will not support micro-organic growth.
   b. Chemical resistance: The work surface shall sustain contact with the following chemical concentrations for 24 hours with no detectable stain, loss of gloss or change.

8. Test Procedure: Cover five drops of each reagent with a 25 mm watch glass convex side up to duplicate the trapping of a reagent under a dispensing container. Test all volatiles by using a one ounce (30 mL) bottle stuffed with saturated cotton. After a 24 hour exposure, flush reagents off with water, clean with naphtha and detergent, rinse and wipe dry.
9. Evaluation Ratings:

0	No effect	No detectable change.
1	Excellent	Slight detectable change in color or gloss.
2	Good	A clearly discernable change in color or gloss but no significant impairment of surface life or function.
3	Fair	Slight surface etching or severe staining.
4	Failure	Pitting, cratering, or erosion of coating. Obvious and significant deterioration.

12. Test results shall not be lower than the following on black material:

Table 1: Acid resistant grade.

Reagent	Concentration	Rating
Amyl acetate		0
Ethyl acetate		0
Acetic acid	98%	0

Reagent	Concentration	Rating
Acetone		0
Acid dichromate	5%	0
Butyl alcohol		0
Ethyl alcohol		0
Methyl alcohol		0
Ammonium hydroxide	28%	0
Benzene		0
Carbon tetrachloride		0
Chloroform		0
Chromic acid	60%	0
Cresol		0
Dichloroacetic acid		0
Dimethylformamide		0
Dioxane		0
Ethyl ether		0
Formaldehyde	37%	0
Formic acid	90%	0
Furfural		0
Gasoline		0
Hydrochloric acid	37%	0
Hydrofluoric acid	48%	3
Hydrogen peroxide	3%	0
Tinture of iodine		0
Methyl ethyl ketone		0
Methylene chloride		0
Mono chlorobenzene		0
Naphthelene		0
Nitric acid	20%	0
Nitric acid	30%	0
Nitric acid	70%	0
Phenol	90%	0
Phosphoric acid	85%	0
Silver nitrate		0
Sodium hydroxide	10%	0
Sodium hydroxide	20%	0
Sodium hydroxide	40%	0
Sodium hydroxide		0
Sodium hydroxide, flake		0
Sodium sulfide, saturated		0
Sulfuric acid	33%	0
Sulfuric acid	77%	0
Sulfuric acid	96%	1
50% Sulfuric acid/50% Nitric acid	77%/70%	0
Toluene		0
Trichloroethylene		0
Xylene		0
Saturated Zinc chloride		0
Aqua regia		0
Betadine (Providine iodine)	10%	0

Table 2: Athlon/Standard grade.

Reagent	Concentration	Rating
Amyl acetate		1
Ethyl acetate		1
Acetic acid	98%	1
Acetone		1
Acid dichromate	5%	0
Butyl alcohol		0
Ethyl alcohol		1
Methyl alcohol		1
Ammonium hydroxide	28%	1
Benzene		0
Carbon tetrachloride		0
Chloroform		1
Chromic acid	60%	1
Cresol		0
Dichloroacetic acid		1
Dimethylformamide		0
Dioxane		0
Ethyl ether		1
Formaldehyde	37%	1
Formic acid	90%	3
Furfural		0
Gasoline		0
Hydrochloric acid	37%	3
Hydrofluoric acid	48%	3
Hydrogen peroxide	3%	3
Tinture of iodine		3
Methyl ethyl ketone		1
Methylene chloride		1
Mono chlorobenzene		1
Naphthelene		0
Nitric acid	20%	1
Nitric acid	30%	1
Nitric acid	70%	3
Phenol	90%	0
Phosphoric acid	85%	3
Silver nitrate		1
Sodium hydroxide	10%	0
Sodium hydroxide	20%	0
Sodium hydroxide	40%	0
Sodium hydroxide, flake		1
Sodium sulfide, saturated		0
Sulfuric acid	33%	1
Sulfuric acid	77%	1
Sulfuric acid	96%	3
50% Sulfuric acid/50%Nitric acid	77%/70%	3
Toluene		0
Trichloroethylene		1
Xylene		0
Saturated Zinc chloride		0
Aqua regia		1
Betadine (Providine iodine)	10%	0

B. Plastic Laminate:

1. Thickness: 1 inch thick unless otherwise noted on Drawings.
2. Fabrication:

   a. Finish at the factory and include all machine drilling and cutouts.
   b. Edges: Band with 1/8 inch PVC. Trim and sand smooth with all edges and corners radiused.
   c. Size Tolerances: Length, plus or minus 1/8 inch. Width, plus or minus 1/16 inch.
   d. Squareness: Plus or minus 1/64 inch for each 12 inches. A top spanning 48 inches; held to plus or minus 1/16 inch.
   e. Location Of Cutouts And Drillings: Plus or minus 1/8 inch
   f. Sizes Of Cutouts And Drillings: Plus 1/8 inch, minus 0.

3. Curbs: Supply loose for field application in same thickness as countertops. Provide curbs 4 inches high unless otherwise indicated on Drawings. Where tops abut wall, casework, of fume hood, supply an end curb. Caulk joints between curb and walls, fume hoods, and cabinets with acid-resistant silicone caulk.
4. Color: To be selected by the Owner's Representative from non standard colors.

2.13 SINKS

A. Epoxy Resin Sink:

1. Available Manufacturers:

   a. Durcon Laboratory Tops.
   b. Epoxyn Products.

2. Description: Integrally molded from modified thermosetting black epoxy resin, and oven cured. Minimum wall thickness of 1/2 inch(12 mm) with all interior corners coved to 1-1/2 inch(36 mm) radius and bottoms pitched to end outlet opening.
3. Sink mounting methods:

   a. Drop-in: Supported by an upper flange from the work surface. Top edge of sink positioned 1/8 inch(3 mm) below the work surface with a 30 degree bevel from the top of the work surface to the top of the sink lip. Joint between sink and work surface shall not exceed 1/8 inch(3 mm)plus or minus 1/16 inch(1.5 mm).
   b. Under Mount: Support sink at bottom using an upper direction compression support system.

4. Seal joint between top and sink with Dow Corning 732 RTV or General Electric SE 1203.
5. Provide sink with the following accessories:

   a. Outlet: 1-1/2 inch(36 mm) NPS.
   b. Overflow: Open end overflow standpipe. Overflow to be 2 inches(50 mm) shorter than depth of sink.
   c. Strainer: Removable disc strainer.
   d. Tailpiece: Town & Country Plastics Model PP-18, R&G Sloane Part Number 7218; or Scientific Plastics Company, Inc., Part Number W81595-158.

B. Stainless Steel Scullery Sink:

1. Fabricate from 14 gage, Type 304 stainless steel with a Number 4 finish. Provide 1 inch radius cove at vertical and horizontal corners and pitch bottom to drain. All sink joints; butt welded, ground smooth and polished to render all joints seamless. Soldering will not be permitted in conjunction with sink unit construction. Provide all sink units designed and fabricated with sufficient reinforcement to prevent oil canning. Apply heavy mastic type sound deadening coating to underside of sinks, tops, backsplashes, and sidesplashes. Fixture holes to be reinforced with a continuous 14 gage hat channel on the backside of the backsplash. Length as required for fixture quantity. Provide 1 inch wide by 4 inch high sidesplash where sink abuts a vertical surface. Caulk joint between sink unit and any vertical surface with an acid-resistant silicone caulk.

2. Sink: Provide with stainless steel open end overflow stand pipe, strainer, and tailpiece. Standpipe to be 2 inches shorter than depth of sink.
3. Frame and leg members: 2 inches square, 14 gage. Provide horizontal front shelf support frame members to be removable as detailed on the Drawings. All other connections welded with a Number 4 finish. Provide leg members with leveling glides.
4. Removable shelves: 14 gage, Type 304 stainless steel with a Number 4 finish. Provide bends on the front and the back of the shelf as detailed on the Drawings to provide shelf support and an intregal backsplash.

2.14 LABORATORY SERVICE FIXTURES

A. General:

1. Installation: Provide and installed at point of use all service fixtures. Connect to the service piping systems specified in Division 22. Provide the product of 1 manufacturer for all laboratory service fixtures, including fixtures supplied with fume hoods. Provide all fixtures designed for laboratory use.
2. Acceptable Manufacturers:

    a. Water Saver Faucet Company. Water Saver fixture numbers are referenced on the Drawings.
    b. Chicago Faucet Company.

3. Materials: Provide the bodies of service valves, fixtures and accessories of cast or forged brass with a minimum copper content of 85 percent. Faucets shall have a tapered body design. Fabricate assembly components and operating parts such as valve stems, renewable units, packing nuts, outlet nozzles, and straight serrated hose ends from solid brass bar stock. Fabricate replaceable seats, needle cones, valve disc screws, and other accessories from monel metal or stainless steel alloys especially selected for use intended.
4. Assembled at the factory: Service fixtures, including the mounting of valves and shanks to turrets, flanges, and other mounting accessories.
5. Furnish and install nipples, locknuts, shanks and other accessories required to properly mount and connect the fixtures.
6. Testing: Individually factory test fixtures. Valves and fixtures, except water fixtures, shall withstand a test pressure of 100 pounds per square inch. Test water fixtures at 80 pounds per square inch. Test fixtures for gases under water.
7. Fixtures located on the same plane shall have their handles project the same distance from the plane of reference to present a uniform, related appearance, regardless of valve type.

B. Water Valves:

1. Renewable unit containing all working parts which are subject to wear, including stainless steel or monel metal seat, monel metal screw, heavy duty seat disk, Teflon packing, and an integral or external adjustable volume control.
2. Provide unit capable of being readily converted from compression to self closing, and vice versa, without disturbing faucet body proper and shall also be capable of being readily converted from water construction to needle valve or steam valve construction without disturbing faucet body.
3. Provide unit sealed in valve body with special composition gasket. Metal-to-metal or ground-joint type of sealing not acceptable.
4. Provide vacuum breakers.

C. Needle Valves:

1. Vacuum, gas, and air needle valves shall have a stainless steel replaceable floating cone that is precision ground and self-centering.
2. Action of valve: Slow compression for fine control under pressure up to 150 psi and shall have parts subject to wear, easily replaceable.

D. Fine Control Valves:

1. Fine Control valves for special gas service: As described for needle valves with the following additions.

   a. Fine stem threads with approximately 30 threads per inch.
   b. Renewable stainless steel needle and seat with 1/8 inch orifice.
   c. Constructed to maintain a constant flow rate of 4 bubbles per 15 seconds as valve is tested out under 50 pounds, 100 pounds, 150 pounds, 200 pounds, and 250 pounds of nitrogen pressure.

E. High Purity Water Valves:

1. Forged brass body with all interior components coming in contact with water constructed of polypropylene.
2. Maximum working pressure of 50 psig.
3. Provide with 3/8 inch brass riser and gooseneck with polypropylene lining.
4. Provide with polypropylene serrated tip at the outlet.

F. Laboratory Ball Valves: Straight pattern body, valve stem with integral chrome plated ball and TFE-coated O-rings stem seals in valve body, molded TFE valve seals, and tested at 125 psi nitrogen under water. Valves shall have chrome plated forged brass lever-type handle with screw-on type index requiring less than 5 pounds pressure to actuate. Provide with removable 10 serrated hose end.

G. Goosenecks: Hot water/cold water gooseneck mixers shall swivel. Provide swivel point at turret or at valve level if wall or panel mounted. Provide swing joints with heavy Teflon packings. All goosenecks shall provide full thread for attachment of antisplash outlet fixtures, serrated tips or filter pumps.

H. Vacuum Breakers: Provide vacuum breakers, integral with the gooseneck where required. Vacuum breakers shall have a forged brass body, renewable seat and a special design valve member for fine flow control. Vacuum breakers shall not spill over at low water volume.

I. Aerators: Aerators shall have 3/8 inch NPS male inlet. Provide with integral flow control that adjusts between 0.5 and 3.0 GPM. Flow control to be set as indicated on Drawings.

J. Serrated Tips: Serrated tip fixtures shall have 3/8 inch IPS thread with hose end being tapered and shall not have less than 10 serrations. Provide 1/8 inch diameter of orifice in serrated tip, except where otherwise specified. For water units provide with integral flow control that adjusts between 0.5 and 3.0 GPM. Flow control to be set as indicated on Drawings.

K. Turrets: Round type design, brass drop forging, as indicated on Drawings. One-way or two-way as required with 3/8 inch IPS female inlet thread for connections. Furnish units with brass shanks, brass locknuts, and washers.

L. Pedestal Type Fixtures: Cast aluminum box complete with cover plates. Fabricate units with sloped single face or double face, as indicated, and conceal mounting holes in base for attaching to casework. Provide holes tapped for conduits and grounding screws. Coordinate required face plates with receptacles and other devices specified in Division 26.

M. Fixture Finish:

1. Chrome finish, over all visible areas, developed by the following sequence of platings over properly prepared brass castings or forgings:

Plating	Minimum Plating Thickness
Copper (Initial)	0.000050 inches
Nickel	0.000350 inches
Chromium (Final)	0.000015 inches

2. Provide laboratory service fixtures with an acid and solvent resisting clear plastic coating applied over a cleaned, polished, chrome plated surface. Spray and bake coating surfaces 3 times with a minimum coating thickness of 2–3 mil. Assemble faucet and valve components after surfaces have been coated, and test at 100 pounds air under water.
3. Test coating by suspending samples in a 6 cubic foot capacity container approximately 12 inches above open beakers, each containing 199 cc of 75 percent nitric acid, 94 percent sulfuric acid, and 37 percent hydrochloric acid, respectively. After exposure to these fumes for 150 hours, finish shall show no rupture, though slight discoloration or possible softening is permissible.

N. Faucet and Valve Handles: Chromeplated, 4-arm type or wrist blade type with removable screw-on type colored plastic discs with identification lettering stamped on disc in a contrasting color as scheduled below.

Service	Disc Color	Lettering Color	Lettering
Steam	Black	White	STM
Nitrogen	Grey	Black	N2
Vacuum	Yellow	Black	VAC
Gas	Blue	White	GAS
Cold Water	Green	White	CW
Hot Water	Red	White	HW
Deionized Water	White	Black	DI
Compressed Air	Orange	Black	AIR
Purified Water	White	Black	PW
Chilled Water	Brown	White	CH
Lab Air	Orange	Black	LA
Industrial Hot Water	Red	White	IHW
Industrial Cold Water	Green	White	ICW
Air	Orange	Black	AIR
Special Gas	Lt. Blue	Black	SG

O. Wrist blade Handles: Install handles so blades are perpendicular to the benchtop in the off position and horizontal to the benchtop in the open position.

2.15 EMERGENCY SHOWER AND EYE WASH UNITS

A. General: Provide and install at point of use all emergency shower and eyewash units. Connection to the service piping systems specified in Division 22. Provide units that meet the requirements of ANSI Standard Z358.1.

B. Acceptable Manufacturers:

1. Water Saver Faucet Company. Water Saver fitting numbers are referenced on the Drawings.
2. Guardian Equipment.
3. Chicago Faucet Company.

C. Emergency Showers:

1. Deluge type with a concealed stay-open ball valve. Provide with "Panic Bar" activation as detailed on the Drawings.
2. Shower head, nipple, and escutcheon: stainless steel. Maximum mounting height of shower head 96 inches.
3. Design valve so that water flow remains on without requiring use of the operator's hands.
4. All exposed valves, piping, and associated devices: Stainless steel.

D. Recessed Swing-Down Eye/Face Wash:

1. Barrier free, wall mounted, "AutoFlow", swing-down eye/face wash with recessed stainless steel cabinet.
2. Furnish and install units to meet the requirements of the Americans With Disabilities Act (ADA).
3. Cabinet: Type 304 stainless steel with Number 3 satin finish.
4. All exposed valve components: Polished chromeplated brass.
5. Valve: Plug-type design with Teflon coated "O" rings to seal valve orifice. Water flow activated by swinging outlet heads from the vertical to the horizontal position. Water to turn on when the arm assembly is no more than 30 degrees from horizontal. Cabinet shall house valve assembly.
6. Furnish with 2 polypropylene fine spray heads with polyurethane filter and integral volume control.
7. Cabinet shall house the emergency shower stay-open ball valve with "Panic Bar" as detailed on the drawings.

E. Deck Mounted Eyewash:

1. Deck mounted, dual purpose eye wash/drench hose.
2. Provide forged brass dual outlet heads, valve, and deck flange.
3. Provide with a push-to-operate, stay-open ball valve.
4. Unit shall have 2 polypropylene gentle spray heads with polyurethane filter, integral volume control and integrated nylon flip-top dust cover.
5. Finish: Match laboratory services fitting finish.

2.16 UMBILICALS

A. Description: Construct of 18 gage sheet metal with collar at top. Provide bottom curb in same material as benchtop, properly glued or cemented to benchtop. Provide top collar of 16 gage sheet steel. Provide 1 inch by 1 inch, 18 gage angle at curb.

B. Umbilicals shall have removable sections for easy access to piping and conduit. Exposed fasteners will not be allowed. Removal of sections shall not disturb ceiling or benchtop. Construct hanger clips of 18 gage sheet metal and spot welded to removable section.

C. On freestanding umbilicals provide a pipe support channel, spot welded to the fixed enclosure section. On wall or corner umbilicals, attach pipe support channel to the wall.

1. Basis of Design: Unistrut

D. Finish: Finish as specified for metal finish in this section, with color selected by Owner's Representative.

2.17 SHELVING

A. Metal Shelves: 16 gage steel shelving with hat-section reinforcing. Provide units interchangeable with wall hung cabinets. Finish as specified for metal finish in this section, with color selection by the Owner's Representative.

B. Retainer Rod: Type 304 stainless steel 1/4 inch diameter rod with a number 4 polished finish. Bend 90 degrees at 1-1/2 inches from each end. Insert bent ends into shelf to a depth of 1/2 inch with horizontal portion of rod at 1 inch above shelf.

C. Adjustable Wall Shelving:

1. Standards: Double-slotted type, 30 inches long unless otherwise noted on Drawings. Satin zinc finish. Garcy Corporation, Number 3225; E.B. Bradley, Number 44; or equal.
2. Brackets: 16 gage metal with 3 blade hooks. Screw shelves to each bracket. Finish as specified for metal finish in this section, with color selected by the Owner's Representative.

D. Adjustable Island Bench Shelving:

1. Standards: Double-slotted type, 30 inches long unless otherwise noted on Drawings. Satin zinc finish. Garcy Corporation, Number 3225; E.B. Bradley, Number 44; or equal.
2. Brackets: 16 gage metal with 3 blade hooks. Screw shelves to each bracket. Finish as specified for metal finish in this section, with color selected by the Owner's Representative.
3. Shelving Support: 2 inches by 3 inches by 12 gage steel, vertical and horizontal tubes with welded connections. Secure vertical tubes to floor and at underside of benchtop, as detailed on the Drawings. Factory finish as specified for metal finish in this section, with color selected by Owner' Representative.
4. Island Shelving Backsplash: 16 gage thick by 2 inch high, steel plate attached to rear edge of shelving with round head screws, with washers, maximum 12 inches on center.

E. Heavy Duty Adjustable Shelving:

1. Standards: Metal channel, Unistrut P-1000, maximum spacing of 48 inches. Length of standard as indicated on the Drawings. Finish as specified for metal finish in this section, with color selected by Owner's Representative.
2. Brackets: Unistrut Series P2493 through P2499, left-hand or right-hand, as indicated on the Drawings. Finish as specified for metal finish in this section, with color selected by Owner's Representative.

2.18 DRYING RACK:

A. Available Manufacturers: Mod-Rack by Inter-Dyne

B. Body: One-piece, 20 gage, Type 304 stainless steel with a Number 4 finish. Provide top with two 90 degree bends and sides with one 90 degree bend. Bottom shall have two 90 degree bends to provide an integral drip trough and catch drain. Provide front with a multiple of T-shaped holes to accommodate pegs.

C. Pegs: Injection molded white polypropylene, 1/2 inch diameter by 6 inches long. T-shaped protrusion on base of pegs shall allow easy removal and replacement without need for tools. Design T-shaped holes to fit protrusion on support pegs for holding single or multiple utensil drip trays, drain shelves, funnel racks, or pipette holders. Provide five 2-3/4 inch peg extenders for each drying rack.

D. Drip Trough: 4 inch wide, 20 gage, Type 304 stainless steel with a 3/8 inch OD stainless drain tube and a stainless steel screen insert. Screen; 16 gage, 14 by 14 mesh, 0.025 wire. Provide with a 3/8 inch ID flexible drain tube minimum of 30 inches long.

E. Provide with hanger to allow removal and replacement of entire rack for cleaning without need for tools.

F. Finished Backs: Provide with all units not mounted on walls. Fabricate from 20 gage, Type 304 stainless steel with a Number 4 finish.

2.19 GAS CYLINDER RESTRAINTS

A. Description: Provide metal framing system members, fastened to the wall or laboratory bench, for mounting of cylinder restraint devices.

B. Metal Framing System Components: Consist of two 12 gage steel P1000 channel members with two male swivel hanger fittings, Number M2350, on each member for each cylinder. Unistrut Part Numbers are referenced. Finish as specified for metal finish in this section, with color selected by Owner's Representative.

1. Acceptable Manufacturers:

a. Unistrut Corporation
b. Elcen
c. Grinnell Power-Strut

C. Chain Restraints: Consist of 3/16 inch diameter Type 316 stainless steel chain Number 3618T715, length as required to restrain a standard 9 or 10 inch gas cylinder, with a Type 316 stainless steel threaded connector

Number 3711T33, on one end of the chain, and a Type 316 stainless steel load rated spring snap with a minimum load rating of 300 pounds, Number 8907T11, on the other end of the chain;

1. Available Manufacturer/Distributer:

    a. McMaster-Carr.

D. Also provide 1.5” Polypropylene Straps length as required with cinch buckles.

2.20 SNORKEL

A. Available Manufacturers:

1. Airflow Systems Inc.

    a. Model; E-Z ARM II.

2. Movex Inc.

    a. Model; MiniTEX MXT 1500-100 with metal hood MM251

B. Description: 4 inch diameter by 60 inches long self supporting telescopic arm.

C. Construction: Extruded aluminum tubes connected with a spiral flex duct. Heavy duty aluminum joints with a friction release system at the middle joint. Spring balanced ring base joint and universal joint at flanged inlet hood. Provide arm with 7 inch end cone, and 6 inch high external collar for duct coupling. Provide connection to existing ductwork which will allow an unrestricted 360 degree movement of the arm.

D. Spiral Flex Duct: Provide with flame spread/smoke developed rated 25/50 as per UL 181

E. Mounting bracket: Provide a mounting bracket as shown on the drawings for each snorkel.

F. Air flow control: Any such device on the snorkel arm such as a manual damper that restricts or stops allows air flow through the snorkel arm is not acceptable. This device must be removed.

G. Finish: Epoxy powder coated white or clear anodized.

2.21 Blackout Curtain and Track Assembly

A. Manufacturers: Products complying with this specification may be provided by the following manufacturers. All products specified in this section shall be the provided by a single manufacturer.

1. PL Systems, 65 Bethpage Rd., Plainview, NY 11803 Tel: 800 422-0101.

2. Aero Shade Co., Inc., Los Angeles CA 90048 Tel: 213 655-2411.

3. Approved substitution.

B. Curtain Materials and Fabrication:

1. The blackout curtain material shall be of the following fabric composition: 38% SEF Modacrylic, 30% Saran Flat Monofilament, 26% Viscose Rayon and 6% Polyester. Material shall have a double-vinyl black color laminated back for opacity (samples must be submitted).

2. The curtain shall be sewn flat with 10% fullness. The seams shall be sewn French-style (no raw edges visible). The curtain top shall be grommeted on 8 inch (200 mm) centers. The bottom edge shall be weighted and overlap the floor approximately 2 inches (50 mm).

3. The outside vertical edges shall be supplied with "Velcro" quick-seal strips to facilitate "light-trap" overlaps for easy light-tight attachment to walls.

4. Curtain shall be supplied with minimum 11 inch (280 mm) high front and rear light-trap valances. The valances shall be made of the same black-out curtain materials, sewn flat (no fullness) with a sewn-on Velcro strip, and shall be mounted to the curtain track assembly using the "Light-Trap-Interface".

5. Blackout curtain must be flame-retardant or made of non-combustible materials. Fabric must pass the flame resistance requirements specified by the State of California test, and be in accordance with the National Fire Protection Association Standard No. 701-99 test methods 1 and 2. Submit certificate of passage to tests.

C. Track Material and Assembly:

1. Construct of satin anodized extruded aluminum box-channel 1-3/8 inches x ¾ inch (35 x 18 mm) slotted on the underside to receive two wheeled carriers designed for surface mounting to the underside of the ceiling. The track shall also serve as an integral part of the valance assembly. Supply with hook carriers, end-caps, snap-outs, and connectors, of the sleeve type. Hooks are formed of rustproof wire and bead chain riding on a carrier with non-wearing nylon wheels. Corners, where required, shall be one-piece, 12 inch (305 mm) radius 90 degree track sections.

2.22 SOURCE QUALITY CONTROL TESTING OF METAL FINISH

A. Metal Finish: Meet or exceed the latest edition of the following Section and Articles of SEFA-8 Recommended Practices;

1. 8.0 Cabinet Surface Finish Test
2. 8.1 Chemical Spot Test
3. 8.2 Hot Water Test
4. 8.3 Impact Test
5. 8.4 Paint Adhesion on Steel
6. 8.5 Paint Hardness on Steel

B. Testing Requirements: Provide a third party tester that is not a representative of the Manufacturer or Installation Contractor

1. Test Results: Submit a certified report providing test results and indicating the finish conforms with or exceeds the above SEFA-8 Recommended Practices.

2.23 Source Quality Control Testing Of Wood Finish

A. Wood Finish: Meet or exceed the latest edition of the following Section and Articles of SEFA-8 Recommended Practices:

1. 8.0 Cabinet Surface Finish Test
2. 8.1 Chemical Spot Test
3. 8.2 Hot Water Test

B. Testing Requirements: Provide a third party tester that is not a representative of the Manufacturer or Installation Contractor

C. Test Results: Submit a certified report providing test results and indicating the finish conforms with or exceeds the above SEFA-8 Recommended Practices.

2.24 Source Quality Control Testing Of Epoxy Resin Work Surface

A. Test Procedure: Apply 5 drops of each reagent to surface and cover with 25 mm watchglass, convex side down; test volatiles using 1 ounce bottle stuffed with saturated cotton. After 24 hour exposure flush surface, clean, rinse and wipe dry.

B. Evaluation Ratings: Describe by the following ratings, changes in surface finish and function:

1. No Effect: No detectable change in surface material.
2. Excellent: Slight detectable change in color or gloss, but no change to the function or life of the work surface material.
3. Good: Clearly discernible change in color or gloss, but no significant impairment of work surface function or life.
4. Fair: Objectionable change in appearance due to surface discoloration or etch, possibly resulting in deterioration of function over an extended period.
5. Failure: Pitting, cratering or erosion of work surface material; obvious and significant deterioration.

C. Test Results: Submit a report of the test results. Provide results equal to or better than the following.

D.

	Reagent	Rating
1.	Hydrochloric Acid, 37 percent	Excellent
2.	Sulfuric Acid, 33 percent	No Effect
3.	Sulfuric Acid, 77 percent	No Effect
4.	Sulfuric Acid, 96 percent	Failure
5.	Formic Acid, 90 percent	Excellent
6.	Nitric Acid, 20 percent	Excellent
7.	Nitric Acid, 30 percent	Excellent
8.	Nitric Acid, 70 percent	Good
9.	Hydrofluoric Acid, 48 percent	Fair
10.	Phosphoric Acid, 85 percent	No Effect
11.	Chromic Acid, 60 percent	Failure
12.	Acetic Acid, 98 percent	Excellent
13.	3 & 8 Equal Parts	Excellent
14.	Ammonium Hydroxide, 28 percent	No Effect
15.	Sodium Hydroxide, 10 percent	No Effect
16.	Sodium Hydroxide, 20 percent	No Effect
17.	Sodium Hydroxide, 40 percent	No Effect
18.	Sodium Hydroxide Flake	No Effect
19.	Sodium Sulfide	Excellent
20.	Zinc Chloride	No Effect
21.	Tincture of Iodine	Excellent
22.	Silver Nitrate	No Effect
23.	Methyl Alcohol	No Effect
24.	Ethyl Alcohol	No Effect
25.	Butyl Alcohol	No Effect
26.	Benzene	Excellent
27.	Xylene	No Effect
28.	Toluene	Excellent
29.	Gasoline	No Effect
30.	Dichloroacetic Acid	Good
31.	Dimethylformamide	Excellent
32.	Ethyl Acetate	No Effect
33.	Amyl Acetate	Excellent
34.	Acetone	Excellent
35.	Chloroform	Excellent
36.	Carbon Tetrachloride	No Effect
37.	Phenol	Excellent
38.	Cresol	Excellent

39.	Formaldehyde	No Effect
40.	Trichlorethylene	Excellent
41.	Ethyl Ether	Excellent
42.	Furfural	Good
43.	Methylene Chloride	Excellent
44.	Monochlorobenzene	Good
45.	Dioxane	Excellent
46.	Methylethyl Ketone	Excellent
47.	Acid Dichromate	Fair
48.	Hydrogen Peroxide	No Effect
49.	Naphthalene	Excellent

2.25 Source Quality Control Testing Of Plastic Laminate Surfaces

A. Test Procedure: Apply five (5) drops of each reagent to surface and cover with watchglass. Saturate 1 inch glass wool balls with 3 cc of solvent and cover with a small beaker. After 16 hours, wash off reagents and solvents with clear water and let dry.

B. Evaluation Ratings: Describe by the following ratings, changes in surface finish and function:

1. A = Unaffected
2. B = Very slight stain or roughening
3. C = Raised or roughened

C. Test Results: Submit a report of the test results. Provide test results equal to or better than the following:

D.	Acids	Result
1.	Nitric, 70 percent	C
2.	Glacial Acetic	A
3.	Sulfuric, 77 percent	A
4.	Sulfuric, 96 percent	C
5.	Hydrochloric, 37 percent	A
6.	Phosphoric, 75 percent	A
7.	Phosphoric, 90 percent	A
8.	Formic, 50 percent	A
9.	Formic, 90 percent	A
10.	Acetic, 10 percent	A
11.	Acetic, 98 percent	A
12.	Hydrofluoric, 48 percent	B
13.	Aqua Regia	A
14.	Chromium Trioxide	B
15.	Perchloric	A
16.	Uric	A

E.	Solvents	Results
1.	Carbon Tetrachloride	A
2.	Carbon Disulfide	A
3.	Acetone	A
4.	Formaldehyde	A
5.	Methanol	A
6.	Ethyl Acetate	A
7.	Toluene	A
8.	n-Hexane	A
9.	Ethyl Ether	A
10.	Chloroform	A
11.	Phenol, 40 percent	B
12.	Phenol, 85 percent	B
13.	Benzene	A

14.	Xylene	A
15.	Butyl Alcohol	A
16.	Amyl Alcohol	A
17.	Amyl Acetate	A
18.	Cresol	A
19.	Methylene Chloride	A
20.	Methylethyl Ketone	A
21.	Naphthalene	A

F. Bases — Results

1.	Sodium Hydroxide, 40 percent	A
2.	Sodium Sulfide	A
3.	Ammonium Hydroxide, 28 percent	A

G. General Reagents — Results

1.	Sodium Hypochlorite, 5 percent	A
2.	Calcium Hypochlorite	A
3.	Hydrogen Peroxide, 3 percent	A
4.	Gasoline	A
5.	Kerosene	A
6.	Mineral Oil	A
7.	Silver Nitrate, 10 percent	A

PART 3 - EXECUTION

3.1 EXAMINATION

A. Acceptance of Surfaces and Conditions: Examine substrates to receive products and systems and associated work for compliance with requirements and other conditions affecting performance. Proceed only when unsatisfactory conditions have been corrected in a manner complying with Contract Documents. Starting work within a particular area will be construed as acceptance of surface conditions.

3.2 INSTALLATION, GENERAL

A. Installation Quality Standards: In addition to standards listed elsewhere, perform Work according to following, unless otherwise specified:

1. Respective manufacturer/fabricator's written installation instructions.
2. Accepted submittals.
3. Contract Documents.

3.3 INSTALLATION

A. Casework Installation:

1. Install, plumb, level, true and straight with no distortions. Shim as required, using concealed shims. Securely anchor to building structure. Where laboratory furniture abuts other finished work, scribe and apply filler strips for accurate fit with fasteners concealed where practicable.

2. Installation of each individual bench run shall start at the high point of the floor under that bench run with levelers screwed in as much as possible.
3. Where required, assemble units into one integral unit with joints flush, tight, and uniform. Align similar adjoining doors and drawers to a tolerance of 1/16 inch.
4. Adjust casework and hardware so that doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by Manufacturer.
5. Securely fasten tall cabinets, fume hood superstructures and tall flammable storage cabinets to solid support material near top of cabinet.
6. Reinforcement of stud walls to support cabinets, shelving, and other wall mounted laboratory furnishing items: Done during wall erection by trade involved. Laboratory furniture company/supplier is responsibility for indicating on Shop Drawings the accurate location and sizing of reinforcement.

B. Wall Cabinet Installation:

1. Securely fasten to solid supporting material, not plaster, lath, or wallboard. Anchor, adjust, and align wall cabinets as specified for base cabinets.
2. Reinforcement of stud walls to support wall mounted cabinets: Done during wall erection by trade involved. Laboratory furniture company/supplier is responsibility for indicating on Shop Drawings the accurate location and sizing of reinforcement.

C. Work Surface Installation:

1. Field jointing where practicable: Made in same manner as factory jointing using dowels, splines, adhesives, and fasteners recommended by Manufacturer. Locate field joints as shown on accepted Shop Drawings, factory prepared so that there is no job site processing of top and edge surfaces.
2. Abut top and edge surfaces in 1 true plane, with internal supports placed to prevent any deflection.
3. Provide all holes and cutouts as required for built-in equipment and mechanical and electrical service fixtures. Prior to making openings, verify size of opening with actual size of equipment to be used. Form inside corners to a radius of not less than 1/8 inch. After sawing, rout and file cutouts to ensure smooth, crack free edges. Seal exposed edges after cutting with a waterproofing material recommended by manufacturer.
4. Secure tops to support with concealed Z-Type, angle type fastening or equivalent devices spaced no more than 3 feet on center.
5. Plastic laminate worktop joints: 1/4 inch diameter bolt type "dog-bone" or "tite-joint" fasteners routed into bottom surface of worktops. Provide flush hairline joints in top units.
6. Epoxy Resin Work Surface Joints: 3/32 inch flush and smooth.
7. Stainless Steel Work Surface joints: Electrically weld all shop and field joints; grind smooth and polish.
8. Caulk joints between curb and walls, fume hoods, and cabinets with acid-resistant silicone caulk.

D. Sink Installation: Set in chemical resistant sealing compound sinks which were not factory installed and secured and supported per manufacturer's recommendations.

E. Accessory Installation: Install accessories and fixtures in accordance with manufacturer's recommendations.

3.4 ADJUSTING

A. Repair or remove and replace defective work, as directed by Owner's Representative upon completion of installation.

B. Adjust doors, drawers, hardware, fixtures and other moving or operating parts to function smoothly.

3.5 CLEANING AND PROTECTION

A. Clean shop finished casework, touch up as required, and remove and refinish damaged or soiled areas.

B. Cover casework for protection against soiling and deterioration during remainder of construction period.

C. Clean countertops with diluted dishwashing liquid and water leaving tops free of all grease and streaks. Use no wax or oils.

D. If steel wool is used in cleaning stainless steel, use only stainless wool.

E. Protect casework before, during, and after installation. Materials damaged due to improper protection are cause for rejection.

3.6 FIELD QUALITY CONTROL

A. Manufacturer/Fabricator's Field Service: Manufacturer/fabricator's qualified technical representative shall inspect first day's Work and periodically inspect Work to ensure installation is proceeding in accordance with manufacturer/fabricator's designs, recommendations, instructions, and warranty requirements. Representative shall submit written reports of each visit indicating observations, findings, and conclusions of inspection.

B. Owner's Testing Agency Field Service: The Owner may employ and pay a qualified independent testing agency to perform field quality control. Materials and installation failing to meet specified requirements shall be replaced at Contractor's expense. Retesting of materials and installations failing to meet specified requirements shall be done at Contractor's expense.

END OF SECTION 123553.13

SECTION 123662 - QUARTZ AGGLOMERATE COUNTERTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Quartz agglomerate countertops, including backsplashes, end splashes, and apron fronts.
2. Plywood substrate, whether indicated or not.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for steel framing and supports for quartz agglomerate countertops.
2. Section 064023 “Interior Architectural Woodwork” for coordination of interior woodwork with quartz agglomerate countertops.
3. Section 093013 "Interior Ceramic Tiling" for quartz agglomerate thresholds.

1.3 ACTION SUBMITTALS

A. Product Data: For countertop materials.

B. Sustainable Design Submittals: Product data indicating compliance with sustainable design performance requirements.

C. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

1. Show locations and details of joints.
2. Show direction of directional pattern, if any.

D. Samples for Verification: For the following products:

1. Countertop material, 6 inches square. Provide a minimum of 3 samples for each color/pattern.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator / installer.

B. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For quartz agglomerate countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: A shop with not less than 10 years' experience regularly engaged in the fabrication of quartz agglomerate countertops that employs skilled workers who custom fabricate products similar to those indicated for this Project and whose products have a record of successful in-service performance. Shop is also a certified participant in WI's Quality Certification Program.

B. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and execution.

1. Build mockup of typical countertop as shown on Drawings.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.8 COORDINATION

A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

1.9 WARRANTY

A. Special Warranty for Quartz Agglomerate Countertops: Manufacturer's standard or customized warranty in which manufacturer agrees to repair or replace quartz agglomerate countertop components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Ten (10) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sustainable Design Performance Requirements: Adhesives and composite wood products shall comply with 2016 CALGreen mandatory measures:

1. Adhesives: Adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers and caulks shall comply with local or regional air pollution control or air quality management district rules where applicable, or SCAQMD Rule 1168 VOC limits, as shown in 2016 CALGreen Tables 5.504.4.1 and 5.504.4.2. Such products also shall comply with the Rule 1168 prohibition on the use of certain toxic compounds (chloroform, ethylene dichloride methylene chloride, perchloroethylene and trichloroethylene). Adhesives shall have no added formaldehyde resins.
2. Composite Wood Products: Hardwood plywood and medium density fiberboard composite wood products used on the interior or exterior of the building shall meet the requirements for formaldehyde as specified in ARB's Air Toxics Control Measure (ATCM) for Composite Wood (17 CCR 93120 et seq.) Those materials not exempted under the ATCM must meet the specified emission limits, as shown in 2016 CALGreen Table 5.504.4.5.

2.2 MANUFACTURERS

A. Basis-of-Design Manufacturer/Product: Subject to compliance with requirements, provide the following:

1. As indicated on Drawings.

B. Source Limitations: Provide quartz agglomerate countertops by single source from single manufacturer.

2.3 QUARTZ AGGLOMERATE COUNTERTOP MATERIALS

A. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of filled plastic resin and complying with ICPA SS-1, except for composition.

1. Quartz Agglomerate Products: As indicated on Drawings.
2. Colors and Patterns: As indicated on Drawings.

2.4 SUBSTRATE MATERIALS

A. Plywood Substrate: Softwood plywood, DOC PS 1, Grade C-C Plugged, touch sanded.

1. Minimum thickness. 3/4 inches.

2.5 COUNTERTOP FABRICATION

A. Fabricate countertops according to quartz agglomerate manufacturer's written instructions and the AWI/AWMAC/WI's "Architectural Woodwork Standards."

1. Grade: Premium.

B. Configuration:

1. Front Edge Profile: As indicated on Drawings.
2. Backsplash: As indicated on Drawings.
3. End Splash: Matching backsplash.

C. Countertops: Quartz agglomerate, in the following thicknesses:

1. Countertops for food service applications: 3 cm (nominal 1-1/8 inch) thickness.
2. Elsewhere: 1/2 inch thickness, with front edge built up with same material.

D. Backsplashes: 1/2-inch- thick, quartz agglomerate.

E. Fabricate tops with shop-applied edges unless otherwise indicated. Comply with quartz agglomerate manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

1. Fabricate with loose backsplashes for field assembly.

F. Joints: Fabricate countertops without joints, unless joints are unavoidable.

G. Where joints are unavoidable, fabricate countertops in sections for joining in field, with joints at locations indicated on approved shop drawings.

1. Joint Locations: Not within 18 inches of a sink or cooktop and not where a countertop section less than 36 inches long would result, unless unavoidable.
2. Fabricate joints between components using manufacturer’s recommended, color matched, joint adhesive, and reinforced per manufacturer’s written installation instructions.

a. Maximum joint width: 1/16 inch.

H. Cutouts and Holes:

1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.

   a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch into fixture opening.

2. Counter-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
3. Countertops for Food Service and/or Food Service Equipment: Comply with quartz agglomerate countertop manufacturer's written fabrication guide for recommendations and written installation instructions for installing quartz agglomerate countertops with hot and cold food service equipment, whether indicated on the Drawings or not.
4. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

2.6 INSTALLATION MATERIALS

A. Adhesive: Product recommended by quartz agglomerate manufacturer.

B. Sealant for Countertops: As specified in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to receive quartz agglomerate countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.

B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with quartz agglomerate manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

C. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.

D. Secure countertops to subtops with adhesive according to quartz agglomerate manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with quartz agglomerate manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

E. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.

1. Install metal splines in kerfs in countertop edges at joints where indicated on approved shop drawings. Fill kerfs with adhesive before inserting splines and remove excess immediately after adjoining units are drawn into position.
2. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.

F. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.

G. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Predrill holes for screws as recommended by manufacturer.

H. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

I. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

3.3 CLEANING AND PROTECTION

A. In-Progress Cleaning: Clean countertops as work progresses. Remove adhesive, grout, mortar, and sealant smears immediately.

B. Remove and replace quartz agglomerate countertops of the following description:

1. Broken, chipped, stained, or otherwise damaged stone. Stone may be repaired if methods and results are approved by Architect.
2. Defective countertops.
3. Defective joints, including misaligned joints.
4. Countertops and joints not matching approved Samples and mockups.
5. Countertops not complying with other requirements indicated.

C. Replace in a manner that results in countertops matching approved Samples and mockups, complying with other requirements, and showing no evidence of replacement.

D. Clean quartz agglomerate countertops no fewer than six days after completion of installation, and again not more than for days before date scheduled for inspections that establish date of Substantial Completion. Clean as recommended in writing by quartz agglomerate manufacturer.

END OF SECTION 123662

SECTION 129300 - SITE FURNISHINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Seating.
2. Tables.
3. Bicycle racks.
4. Trash receptacles.
5. Bollards.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for installing pipe sleeves cast, and installing anchor bolts cast in concrete footings.
2. Section 312000 "Earth Moving" for excavation for installing concrete footings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

C. Samples for Initial Selection: For units with factory-applied finishes.

D. Samples for Verification: For each type of exposed finish, not less than 6-inch- long linear components and 4-inch- square sheet components.

E. Product Schedule: For site furnishings. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates: For site furnishings manufactured with preservative-treated wood.

1. Indicate type of preservative used and net amount of preservative retained. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For site furnishings to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 SEATING

A. Emu Americas, LLC – Segno Chair #268

B. Frame: Square Tube Steel

C. Seat and Back:

1. Material:

a. Steel: Steel Slats

2. Seat Height: 18”.
3. Seat Surface Shape: Contoured.
4. Overall Height: 33”.
5. Overall Width: 20.5”.
6. Overall Depth: 21”.
7. Arms: Two, one at each end.

a. Arm Material: Match frame and seat.

8. Weight: As Indicated.
9. Seating Configuration: Multiple units per plan.

D. Aluminum Finish: Glossy Aluminum.

1. Color: As indicated by manufacturer's designation.

E. Landscape Forms, FGP Backed Bench with Ipe Wood Slats in 70” length

F. Frame: Cast Aluminum

G. Seat and Back:

1. Material:

a. Wood: Ipe Solid Stock, select South American hardwood

2. Seat Height: As indicated by manufacturer.
3. Seat Surface Shape: As indicated by manufacturer.
4. Overall Height: As indicated by manufacturer.
5. Overall Width: 70”.
6. Overall Depth: As indicated by manufacturer.
7. Arms: Two, one at each end.

a. Arm Material: Match frame.

8. Weight: As Indicated.

H. Aluminum Finish: Glossy Aluminum.

1. Color: As indicated by manufacturer's designation.

2.2 TABLES

A. Emu Americas – Segno *853 32” diameter table

B. Frame: Steel.

C. Table Top:

1. Material:
   a. Steel: Solid.

2. Surface Shape: Round

D. Aluminum Finish: Glossy Aluminum.

1. Color: As indicated in a site furnishing schedule.

E. Steel Finish: Glossy Aluminum.

1. Color: As indicated in a site furnishing schedule.

F. Custom Table – 10’ Outdoor Ipe Dining Table

G. Frame: Steel.

H. Table Top:

1. Material:

   a. Wood: Ipe Slats.

2. Surface Shape: Square

I. Wood Finish: Stain and transparent finish.

1. Stain: Oil based finish with ultraviolet inhibitors.

J. Graphics: Surface-applied silk screen gaming surface.

2.3 BICYCLE RACKS

A. Forms and Surfaces

B. Bicycle Rack Construction:

1. Frame: Solid Cast Aluminum.

   a. Hardware and mounting plate: stainless steel.

2. Style: Double-side parking.

   a. Overall Height: 34”.
   b. Overall Width: 4”.
   c. Overall Depth: 5”.

d. Capacity: Designed to accommodate no fewer than two bicycles.

3. Security: Designed to lock frame.
4. Installation Method: Surface mount with embedded anchors. Stainless steel anchors and tamper-resistant stainless steel screws are included.

C. Aluminum Finish: Gray Polyester powder coat].

1. Color: As indicated by manufacturer's designation.

2.4 TRASH RECEPTACLES

A. Forms and Surfaces – Orbit Litter and Recycling Receptacle

B. Stainless-Steel Facing Surrounds: Stainless Steel, Sandstone, Scape Perforation.

C. Support Frames: Cast aluminum top and bottom rings with stainless steel supports.

D. Trash Receptacles:

1. Receptacle Shape and Form: Round cylinder.
2. Lids and Tops: Cast aluminum.

a. Description: Standard Texture from Forms+Surfaces Powdercoat Chart.
b. Opening for depositing trash covered by split stream top.

3. Receptacle Height: 32”.
4. Overall Width: 21”.
5. Weight: 77 lbs.
6. Inner Container: Per manufacturer.
7. Disposable Liners: Provide receptacle designed to accommodate disposable liners.
8. Capacity: (2) 13 gallon liners
9. Service Access: Removable lid or top.

E. Stainless-Steel Finish: Sandstone, Scape Perforation

F. Graphics: According to manufacturer's standard.

1. Copy: Litter and Recycle.

2.5 BOLLARDS

A. Cal Pipe – Fixed Stainless Steel Security Bollard

B. Bollard Construction:

1. Pipe OD: Not less than 5”.
   a. Stainless Steel: Pipe sch. 80 T304 SS.
2. Style: Flat Top
3. Overall Height: 36” above grade.
4. Overall Width: 5”.
5. Overall Depth: Per manufacturer.
6. Installation Method: Cast in concrete.

C. Stainless-Steel Finish: No. 4 Brushed finish.

D. Cal Pipe – Internal Locking Removable Stainless Steel Security Bollard with Embedment Sleeve

E. Bollard Construction:

1. Pipe OD: Not less than 5”.
   a. Stainless Steel: Pipe sch. 80 T304 SS.
2. Style: Flat Top
3. Overall Height: 36” above grade.
4. Overall Width: 5”.
5. Overall Depth: Per manufacturer.
6. Installation Method: Cast in concrete.

F. Stainless-Steel Finish: No. 4 Brushed finish.

2.6 MATERIALS

A. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated; free of surface blemishes and complying with the following:

1. Rolled or Cold-Finished Bars, Rods, and Wire: ASTM B 211 (ASTM B 211M).
2. Extruded Bars, Rods, Wire, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
3. Structural Pipe and Tube: ASTM B 429/B 429M.
4. Sheet and Plate: ASTM B 209 (ASTM B 209M).
5. Castings: ASTM B 26/B 26M.

B. Steel and Iron: Free of surface blemishes and complying with the following:

1. Plates, Shapes, and Bars: ASTM A 36/A 36M.
2. Steel Pipe: Standard-weight steel pipe complying with ASTM A 53/A 53M, or electric-resistance-welded pipe complying with ASTM A 135/A 135M.
3. Tubing: Cold-formed steel tubing complying with ASTM A 500/A 500M.
4. Mechanical Tubing: Cold-rolled, electric-resistance-welded carbon or alloy steel tubing complying with ASTM A 513/A 513M, or steel tubing fabricated from steel complying with ASTM A 1011/A 1011M and complying with dimensional tolerances in ASTM A 500/A 500M; zinc coated internally and externally.
5. Sheet: Commercial steel sheet complying with ASTM A 1011/A 1011M.
6. Perforated Metal: From steel sheet not less than 0.090-inch nominal thickness; manufacturer's standard perforation pattern.
7. Expanded Metal: Carbon-steel sheets, deburred after expansion, and complying with ASTM F 1267.
8. Malleable-Iron Castings: ASTM A 47/A 47M, grade as recommended by fabricator for type of use intended.
9. Gray-Iron Castings: ASTM A 48/A 48M, Class 200.

C. Stainless Steel: Free of surface blemishes and complying with the following:

1. Sheet, Strip, Plate, and Flat Bars: ASTM A 666.
2. Pipe: Schedule 40 steel pipe complying with ASTM A 312/A 312M.
3. Tubing: ASTM A 554.

D. Wood: Surfaced smooth on four sides with eased edges; kiln dried, free of knots, solid stock of species indicated.

1. Wood Species: Manufacturer's standard**.**

   a. Douglas Fir: Clear Grade, vertical grain.
   b. Western Red Cedar: Select Grade or better.

c. Ipe: Select Grade or better.

E. Fiberglass: Multiple laminations of glass-fiber-reinforced polyester resin with UV-light stable, colorfast, nonfading, weather- and stain-resistant, colored polyester gel coat, and with manufacturer's standard finish.

F. Plastic: Color impregnated, color and UV-light stabilized, and mold resistant.

1. Polyethylene: Fabricated from virgin plastic HDPE resin.

G. Anchors, Fasteners, Fittings, and Hardware: Stainless steel, Galvanized steel zinc-plated steel, , Manufacturer's standard, corrosion-resistant-coated or noncorrodible materials; commercial quality, tamperproof, vandal and theft resistant, concealed, recessed, and capped or plugged.

1. Angle Anchors: For inconspicuously bolting legs of site furnishings to below-grade substrate; per manufacturer’s recommendation.
2. Antitheft Hold-Down Brackets: For securing site furnishings to substrate; extent as indicated on Drawings.

H. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M; recommended in writing by manufacturer, for exterior applications.

I. Erosion-Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound; resistant to erosion from water exposure without needing protection by a sealer or waterproof coating; recommended in writing by manufacturer, for exterior applications.

J. Galvanizing: Where indicated for steel and iron components, provide the following protective zinc coating applied to components after fabrication:

1. Zinc-Coated Tubing: External, zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq. ft. (0.27 kg/sq. m) of zinc after welding, a chromate conversion coating, and a clear, polymer film. Internal, same as external or consisting of 81 percent zinc pigmented coating, not less than 0.3 mil (0.0076 mm) thick.
2. Hot-Dip Galvanizing: According to ASTM A 123/A 123M, ASTM A 153/A 153M, or ASTM A 924/A 924M.

2.7 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment: Pressure-treat wood according to AWPA U1, Use Category UC3b, and the following:

1. Use preservative chemicals acceptable to authorities having jurisdiction and containing no arsenic or chromium. Use chemical formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
2. Kiln-dry lumber and plywood after treatment to a maximum moisture content, respectively, of 19 and 15 percent. Do not use materials that are warped or do not comply with requirements for untreated materials.

2.8 FABRICATION

A. Metal Components: Form to required shapes and sizes with true, consistent curves, lines, and angles. Separate metals from dissimilar materials to prevent electrolytic action.

B. Welded Connections: Weld connections continuously. Weld solid members with full-length, full-penetration welds and hollow members with full-circumference welds. At exposed connections, finish surfaces smooth

and blended, so no roughness or unevenness shows after finishing and welded surface matches contours of adjoining surfaces.

C. Pipes and Tubes: Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.

D. Preservative-Treated Wood Components: Complete fabrication of treated items before treatment if possible. If cut after treatment, apply field treatment complying with AWPA M4 to cut surfaces.

E. Exposed Surfaces: Polished, sanded, or otherwise finished; all surfaces smooth, free of burrs, barbs, splinters, and sharpness; all edges and ends rolled, rounded, or capped.

F. Factory Assembly: Factory assemble components to greatest extent possible to minimize field assembly. Clearly mark units for assembly in the field.

2.9 GENERAL FINISH REQUIREMENTS

A. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.10 ALUMINUM FINISHES

A. Powder-Coat Finish: Manufacturer's standard polyester powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

2.11 STEEL AND GALVANIZED-STEEL FINISHES

A. Powder-Coat Finish: Manufacturer's standard polyester, powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

B. PVC Finish: Manufacturer's standard, UV-light stabilized, mold-resistant, slip-resistant, matte-textured, dipped or sprayed-on, PVC-plastisol finish, with flame retardant added; complying with coating manufacturer's written instructions for pretreatment, application, and minimum dry film thickness.

2.12 IRON FINISHES

A. Powder-Coat Finish: Manufacturer's standard polyester powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

2.13 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run directional finishes with long dimension of each piece.
2. Directional Satin Finish: No 4.
3. Dull Satin Finish: No. 6.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.

B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.

C. Install site furnishings level, plumb, true, and securely anchored at locations indicated on Drawings.

D. Post Setting: Set cast-in support posts in concrete footing with smooth top, shaped to shed water. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at correct angle and are aligned and at correct height and spacing. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.

E. Posts Set into Voids in Concrete: Form or core-drill holes for installing posts in concrete to depth recommended in writing by manufacturer of site furnishings and 3/4 inch (19 mm) larger than OD of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.

F. Pipe Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.

END OF SECTION 129300

SECTION 132100 - CONTROLLED ENVIRONMENT ROOMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Providing all labor, materials, equipment and services necessary for the complete installation of environmental rooms in accordance with the Contract Documents.
2. Factory assembly and testing of major components, including conditioning module, compressor / condensing unit, humidification / dehumidification equipment, and control panels.
3. Delivery of room components to their final location, and assembly of rooms in place by factory trained technicians.
4. Refrigeration piping, electrical power wiring, control wiring and final connections to equipment and devices which are an integral part of the rooms.
5. Interconnection to building mechanical, plumbing and electrical services.
6. Startup and field testing of rooms by factory trained technical personnel.

B. Related Sections:

1. Division 26 Section(s): Furnishing and installation of electrical utilities and final connections to room control panels and remote compressor/condenser unit control panels.

1.2 REFERENCES

A. Standards:

1. ARI: American Refrigeration Institute, 420-77 and 520-78.
2. ASHRAE: American Society of Heating, Refrigeration and Air Conditioning Engineers, Standard 15-1994 - Refrigeration Components, Safety and Use of Refrigerants.
3. ANSI: American National Standards Institute, B9.1.
4. ASHRAE/ANSI Standard 15-70.
5. ASTM: American Society for Testing and Materials, A204 - Aluminum Alloy, Sheet and Plate.
6. ASTM: American Society for Testing and Materials, A240 - Stainless Chromium-Nickel-Steel, Sheet and Strip.
7. ASTM: American Society for Testing and Materials, A-525 - Steel Sheet, Zinc-Coated, Physical Structural Quality.
8. UL: Underwriters Laboratories Inc., 723 - Room Panel Flame Spread Ratings.
9. A.S.S.C.: American Standard Safety Code for Mechanical Refrigeration, ANS B9.1.
10. FM: Factory Mutual's approval including labeling of insulated panels.

B. Codes:

1. NEC: National Electrical Code Article 310 and 410 – Electric Motors.
2. NFPA: National Fire Code, 79 - Electrical Standard for Industrial Machinery.

1.3 SYSTEM DESCRIPTION

A. Design Requirements:

1. Environmental rooms shall be designed, manufactured, and installed by one supplier for single source responsibility.
2. Rooms shall be self contained units with all essential systems and equipment necessary for a complete and functional room.

3. Design systems with sufficient capacity to simultaneously and continuously meet all loads; including heat transmission from external sources, ventilation load, and internal heat gain from equipment, lighting and people; as scheduled on the drawings. Scheduled power supply represents the amount of power allocated by the building electrical system design for each environmental room. Provide any additional power, in excess of the amount scheduled, that is required to maintain specified environmental conditions.
4. The environmental room design and installation shall conform to applicable codes, ordinances and regulations.
5. Cold Rooms to have redundant conditioning systems.

B. Performance Requirements:

1. Achieve the environmental room temperature and humidity conditions scheduled on the Drawings and maintain the conditions within the specified tolerances.

1.4 SUBMITTALS

A. Manufacturer's Data: Submit, for approval, manufacturer's data for all environmental room components including room structural panels, conditioning modules, compressor / condensing units, humidification / dehumidification equipment, control panels, lighting fixtures and flooring.

B. Shop Drawings: Submit shop drawings, minimum scale 1/4 inch = 1'-0", which include dimensioned plans, elevations, and sections. Provide utility data, details, and other information required for proper evaluation of work and for coordination with other related work.

C. Submittal shall include calculations for cooling, heating, and dehumidification loads and required equipment capacities. Provide refrigeration piping schematic showing all components and their respective size or capacity, airflow schematic, and written sequence of operation for the refrigeration system.

D. Electrical plan shall show all power connections to lighting and equipment; the voltage, amperage, and kW load for each circuit; and control and power wiring schematics.

E. Provide roughing in requirements for mechanical and electrical services.

F. Test Reports: Submit reports of all specified factory and field performance tests.

G. Operating and Maintenance Manuals: Before request for final payment, provide Operating and Maintenance Manuals that reflect installed conditions and provide detailed operating and maintenance procedures.

1.5 QUALITY ASSURANCE

A. Single Source Responsibility: Environmental rooms and associated equipment shall be provided by a single laboratory environmental room manufacturer.

B. Manufacturer's Qualifications:

1. 10 years or more experience in the manufacture and installation of laboratory environmental rooms and equipment of type specified.
2. 10 installations of equal or larger size and with similar requirements.

C. Installer's Qualifications: Technicians factory trained and experienced in the architectural, mechanical and electrical skills necessary to assemble and put the environmental rooms into operation.

1.6 DELIVERY, STORAGE AND HANDLING

A. Schedule delivery of environmental room components and equipment when building spaces are sufficiently complete so that material can be installed immediately following delivery.

B. Protect finished surfaces from soiling or damage during handling and installation. Keep covered with polyethylene film or other protective coating.

1.7 PROJECT CONDITIONS

A. Do not deliver or install equipment until windows and doors are installed and the building is secure and weathertight.

B. Examine project conditions at the site with regard to access, dimensions and the general areas of work. Installation work shall be performed in close coordination with other trades.

C. Provide for any mechanical or electrical service different than that shown on the construction Drawings or indicated in these Specifications, but necessary to accommodate the manufacturer's product requirements.

1.8 WARRANTY

A. Provide a written warranty stating the product is free from defects in material or workmanship under normal use and service. Warranty shall become effective following the acceptance date and cover the following items for the noted duration:

1. 10 year insulated panel warranty.
2. 5 year compressor warranty.
3. 1 year parts warranty.
4. 1 year labor warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specified requirements, provide products by one of the following:

1. Duracold
   1551 South Primrose Avenue
   Monrovia, CA 91016
   (626) 358-1710

2. Environmental Growth Chambers
   P.O. Box 390
   Chagrin Falls, Ohio 44022
   (800) 321-6854

3. Environmental Specialties, Inc.
   4412 Tryon Road
   Raleigh, North Carolina 27606
   (919) 829-9300

4. Harris Environmental Systems
   11 Connector Road
   Andover, Massachusetts 01810
   (978) 470-8600

2.2 ROOM CONSTRUCTION

A. Rooms shall be of modular construction incorporating wall, roof and floor panels consisting of foamed-in-place polyurethane insulation sandwiched between interior and exterior metal surfaces. Provide panels in standard size increments, fully interchangeable, and in a configuration that meets the specified dimensions. Structural metal, wood, or fiberglass material shall not be used between interior and exterior surfaces.

B. Insulation: Foamed-in-place non-CFC polyurethane with a (R30) minimum for 4 inch thick panels. Foam shall be 97 percent closed cell, impervious to moisture. Insulation shall bond the panel and have a minimum compressive strength of 28 pounds per square inch. Insulated panels shall comply with current EPA Regulations for CFC emission.

C. Assembly: Panel sections shall lock together from inside the room with non-corrosive cam type fasteners, providing accurate, tight joining. Provide a minimum of 3 locking devices on each vertical joint. Distance between locking devices shall not exceed 48 inches. Edge of panels shall be tongue and groove construction with every tongue including an interior and exterior flexible vinyl gasket to ensure a tight fit. Batten strips or pressure clips as a means of covering seams or joining panel sections shall not be utilized. Close wrench holes with flush mounted plastic or stainless steel caps.

D. Panels shall have a flame spread of not more than 25 and a smoke generation of 450 or less when tested in accordance with ASTM E84 and as certified by Underwriters Laboratories.

E. Wall Panels:

1. Thickness: 4 inches.
2. Interior Surfaces:

    a. 0.04 inch stucco embossed aluminum with white polyester enamel finish.

3. Exterior Surfaces:

    a. 0.04 inch stucco embossed aluminum with white polyester enamel finish.

4. Reinforce wall panels to support wall mounted shelving shown on the Drawings.

F. Roof Panels:

1. Thickness: 4 inches.

    a. 0.04 inch stucco embossed aluminum with white polyester enamel finish.

2. Exterior Surfaces:
    a. 0.04 inch stucco embossed aluminum with an exposed mill finish.

3. Reinforce roof panels to support equipment loads without violating the insulation value of the panels.

G. Floor Panels:

1. In rooms without floors, the wall panels shall be sealed to floor with continuous caulking bead and 1 inch by 3/4 inch angle screed secured with concrete fasteners and fitted into preformed slot in bottom of wall panel. Wall to floor joint shall be further finished with NSF cove base interior.

H. Doors:

1. Infitting, semiflush, with a minimum clear opening of 36 inches wide by 78 inches high. Doors shall have a thermal resistance within 10 percent of that for wall panels.
2. Observation Window: Minimum of 18 inches by 12 inches, 3 pane with 1/4 inch air space between panes. Windows shall be removable for replacement.
3. Gaskets: Extruded vinyl, resistant to oils and sunlight, and easily replaceable. Provide antisweat heaters to control condensation as a standard item on all door jambs at rooms designed for operation below 5 degrees Celsius.
4. Hardware: Polished aluminum, cam action type, self closing, self lubricating, and edge or strap mounted with stainless steel. A minimum of 2 hinges per door, adjustable for proper gasket seal.
5. Lock: Provide with keyed cylinder lock capable of release from the room interior whether or not the door is locked.

I. Glass Doors:

1. Provide the following rooms with full height glass doors in MCI cold room (see LF plans).
2. Self-closing, 3-pane, fully tempered safety glass, adjustable vinyl wiper gasket, aluminum frame, heated threshold, and torque closer with magnetic sealing and 90 degree stop.

J. Closure Panels:

1. Furnish and install vertical and horizontal closure panels, strips and shrouds to close opening between environmental rooms and adjacent building partitions and ceiling.
2. Finish to match adjoining environmental room wall panels.

2.3 ROOM INTERIORS

A. Lay in Ceiling: Not Required.

B. Flooring:

1. Manufacturer: Altro, Armstrong or Mannington equal to Altro Walkway 20 Safety Flooring.
2. Crevice free, non-absorbent, slip resistant, abrasive, vinyl flooring.
3. Depending on room size, floors shall be seamless or have welded seams, coved 4 inch up sides and capped with vinyl trim piece and continuously silicone sealed between vinyl cap and walls.
4. Color: Selected by the Owner's Representative from one of the manufacturer's standard colors.
5. Flooring shall have temperature stability, dimensional stability and flexibility from -20 degrees Celsius to 60 degrees Celsius.
6. Flooring shall meet the current slip resistance Static Coefficient of Friction Guidelines of the Americans with Disabilities Act and OSHA, and be unaffected by surface water.
7. Provide flooring with an underlayment as recommended by the flooring manufacturer.

C. Conditioning Module:

1. Room air shall be temperature conditioned by a conditioning module consisting of an evaporator coil with drain pan, air circulating blowers and controls.
2. Remote conditioning module.
3. Electrical power feed to conditioning module shall be through the environmental room control panel.

D. Lighting:

1. Design: Lighting shall be sufficient to provide 70 foot-candles of uniform illumination when measured at 36 inches above the floor.
2. Mount fixtures above the false ceiling panels.
3. Fixtures: Vapor proof fluorescent type with low temperature ballast suitable for the temperature listed in the Environmental Room Schedule. Underwriters Laboratories approved 120/60/1.
4. Lamps: Provide type specified under Division 16. For rooms at 0 degrees Celsius and below, provide low temperature lamps.
5. Switch: Provide with pilot light and locate outside of the room next to the door.

E. Freestanding Shelving Units:

1. Not Required.

F. Wall Mounted Shelving:

1. Not Required.

2.4 REFRIGERATION SYSTEM

A. Design:

1. Complete integrated system consisting of a conditioning module, compressor / condenser unit, interconnecting piping, interconnecting wiring, and controls designed for continuous system operation. The refrigeration system shall be a fully modulating type which continuously proportions the mixture of liquid and hot gas phases of the refrigerant entering the evaporator, utilizing a modulating control valve. On/off solenoid valve type of control will not be acceptable. The system shall also include high/low pressure controls, receiver, expansion valve, and all necessary components for a complete system to achieve the specified performance.
2. System capacity shall be sufficient to simultaneously and continuously meet all loads, from 0 to 100 percent, including heat transmission from external sources, ventilation load and internal heat gain from equipment, lighting and people.
3. Refrigerant: R-134A or R-404A for rooms 4 degrees Celsius and above, R-404A for freezers.
4. Ventilation will be continuously provided from the building supply air system, for all rooms 4 degrees Celsius and above. Rooms must maintain temperature control and uniformity with ventilation load continuously present.

B. Conditioning Module:

1. Evaporator Coil: Copper tube, copper fin with aluminum housing. Maximum 8 fins per inch, minimum 4 rows deep. Air velocity shall be less than 500 fpm.
2. Coil Blower Motor: Permanently lubricated, ball bearing design, rubber mounted, and thermally protected.
3. Drain Pans: Provide an insulated, stainless steel or heavy gage aluminum, condensate drain pan large enough to collect all condensate during normal operating and defrost cycles.

C. Compressor/Condenser Unit:

1. Air cooled, semi-hermetic, serviceable unit sized to maintain temperature / humidity conditions scheduled for each room on the drawings. Units shall be selected for operation at 110 degrees Fahrenheit ambient temperature.
2. Manufacturer: Copeland Corporation; Sidney, Ohio.
3. All components of the unit shall be designed for 125 psig working pressure or 150 percent of maximum operating pressure, whichever is greater.
4. Unit shall have a minimum of a high/low pressure safety control, receiver with fusible plug, liquid line drier with sight glass, crankcase pressure regulator, accumulator, vibration absorbers and thermal protection.
5. Unit shall be designed for continuous operation for maximum compressor life and to eliminate on-and-off cycling.
6. The compressor / condenser unit shall be linked to an evaporator of matching capacity.
7. Units located outdoors or in an unprotected area shall have a weatherproof housing, low ambient protection and crankcase heaters.

D. Automatic Defrost System:

1. For rooms with setpoint temperature between 0 degrees Celsius and 6 degrees Celsius, provide hot gas defrost with timer and fan delay switch. Set defrost initiation time and duration so that room temperature increase is minimized while achieving complete removal of accumulated frost. Electric heat trace and insulate drain pipe.
2. For rooms with setpoint temperature 0 degrees Celsius and below, provide electric defrost with timer and fan delay switch. Set defrost initiation time and duration so that room temperature increase is minimized while achieving complete removal of accumulated frost. Electric heat trace and insulate drain pipe.

E. Piping: ACR type, hard drawn, cleaned and capped Type L copper tubing soldered with silver solder. Hot gas piping shall be silver brazed. All piping shall be installed to allow for linear expansion of copper after startup.

1. Suction Piping: Size for velocity of 500-700 fpm on horizontal runs with a slight pitch toward condensing unit. When condensing unit is located below evaporator and there is no possibility of trapping oil; size vertical runs same as horizontal runs. When condensing unit is located above evaporator; size vertical runs for velocity of 1,000–1,500 fpm and install proper traps spaced not more than 10 feet apart on all tubing risers.
2. Hot Gas Piping: When hot gas piping is field installed remote from compressor, size at same velocities and with same trap requirements as specified above for suction lines.
3. Liquid Piping: Size all liquid piping for maximum 2 psig pressure drop.

4. Hangers: Provide with appropriate tubing clamps to support liquid, suction, and discharge lines individually. Space hangers or clamps 8 feet on center maximum.
5. Condensate Drain Piping: Provide 7/8 inch or greater, Type L copper tubing from evaporator drain pan to the building waste system. In rooms with sinks, drain piping shall be connected to the sink drain on the house side of the trap. In rooms without sinks, drain piping shall terminate 2 inches above the floor sink or floor drain outside the room. Horizontal piping between drain pan and environmental room wall shall be located above the lay in ceiling and pitched in the direction of flow. Rigidly support piping at walls, 3 feet on center with a 1 inch clear space between the wall and the drain line. Provide cleanout tee near drain pan. Where piping passes through wall of room, provide chrome plated escutcheons on both faces of the wall and a trap seal at the outside surface of the wall. Insulate and electric heat trace drain piping.
6. Refrigerant Testing: Pressurize and leak test entire system at not less than 100 psig. Clean and dehydrate by maintaining a vacuum of 500 microns, or lower, for a 5 hour period. Add required charge of refrigerant, and oil if necessary, and test entire system for performance. The type of refrigerant used shall be in accordance with State and Local Codes. Mark each system clearly as to refrigerant type used.
7. Service line penetrations shall be properly sealed with silicone caulking.

F. Insulation: Suction and hot gas refrigeration lines shall be insulated with a closed cell foam plastic insulation. The material shall be tubular in form and sized according to the pipe size. Joints shall be thoroughly bonded by the adhesive recommended by the manufacturer of the insulation. Insulation shall meet local and state fire and smoke requirements. Penetrations of the insulation must be thoroughly sealed to form a complete vapor barrier. Wherever the insulation terminates the edges shall be sealed to the pipe with sealant.

2.5 VENTILATON SYSTEM

A. Not Required.

2.6 DEHUMIDIFIERS

A. Required for level 2 cold room #223.

2.7 HUMIDIFIERS

A. Not Required.

2.8 CONTROLS

A. Locate all instruments and controls in a control panel on the outside of the room, mounted at eye level. Provide panel with a clear acrylic cover and a lock with two keys.

B. Control Panel Service Enclosure: Provide a removable service enclosure panel from control panel to 6 inches above ceiling. Exposed fasteners will not be allowed. Finish to match control panel.

C. Main Temperature Control: Microprocessor based PID controller designed for environmental room applications with the following features:

1. Resistance Temperature Detector (RTD) 100 ohm platinum sensor for rapid response to temperature fluctuation, open tip for environmental rooms. Sensitivity shall be greater than or equal to plus or minus 0.1 degree Celsius.
2. The microprocessor PID controller shall continuously monitor room condition versus setpoint, providing an output which will modify the conditioning system capacity in response to any deviation.
3. Controller range shall be established to cover the required range of the room as scheduled.
4. Accuracy: Plus or minus 0.25 percent of reading plus 1 digit over advertised span at 25 degrees Celsius.

5. Ambient Temperature Error: 0.01 percent of span per degree Celsius deviation from 25 degrees Celsius.
6. Resolution: 1 degree/unit.
7. Calibration Drift: Self compensating for ambient temperature. All calibration values shall be stored in memory. No field calibration shall be required.
8. Noise Rejection: Normal mode, 85 dB minimum at 60 Hertz or greater. Common mode, 90 dB minimum.

D. High Temperature Safety Control: Provide a separate and independent safety control circuit and devices installed in the control panel. This control shall be a sensitive electronic controller with setpoint dial calibrated in degrees Celsius. In the event of a high temperature alarm condition, the safety control will de-energize the heaters and lights in the room and activate an audible and visual alarm. A panel mounted momentary contact push button shall be provided to deactivate only the audible portion of the alarm. When temperature returns to the normal range the heaters, lights, and alarm system shall automatically reset. Provide dry contact for connection to external alarm.

E. Low Temperature Safety Control: Provide a separate and independent safety control circuit and devices installed in the control panel. Its sole function shall be to deactivate the refrigeration system and activate audible and visual alarms in the event of a low temperature alarm condition. This control shall be a sensitive electronic controller with setpoint dial calibrated in degrees Celsius. A panel mounted momentary contact push button shall be provided to deactivate only the audible portion of the alarm. When temperature returns to the normal range the alarm system shall automatically reset. Provide dry contact for connection to external alarm.

F. Temperature Recorder: Not Required.

2.9 PERSONNEL EMERGENCY ALARM

A. Provide room with a reset type, electrically powered personnel emergency alarm system. Power shall be from the room electrical input. The system shall consist of an actuator within the room and audible and visual alarms affixed to the front exterior of the room. Provide an additional alarm for the building automation system utilizing two dry contacts.

B. The alarm system actuator shall be a heavy duty, oil tight switch, equipped with a red button marked, "EMERGENCY ALARM - PULL TO RESET." The actuator shall be mounted on the interior wall of the room adjacent to the door jamb and 12 inches above the finish floor.

C. The audible alarm shall be of a type that provides a high decibel level of sound output at a frequency distinct from room parameter alarms. The visual alarm shall be mounted in an area providing no vision interference and shall be prominently labeled "PERSONNEL EMERGENCY.”

PART 3 - EXECUTION

3.1 INSTALLATION

A. Deliver to job site, uncrate, and assemble all equipment specified herein. All debris and crating materials shall be removed. Components shall not be exposed to weather.

B. Sections shall match without distortion. Door shall close and seal without binding.

C. Electrical:

1. Furnishing, installation and connection of control panel, complete with disconnects for incoming service and branch circuits.
2. Incoming service to control panel mounted disconnects from junction box located above the environmental room.

3. Interlocking control wiring between control panel and compressor/condenser units, conditioning module, dehumidifiers, humidifiers and heaters.
4. Provide a dry contact, for use by building automation system, that will close when any of the operating controls fail or when any of the safety devices prevent operation of conditioning equipment.
5. Provide seal-off fitting to seal conduit and prevent condensation at all penetrations of environmental room wall or roof panels.
6. Provide packaged compressor units complete with disconnects and motor starters.

D. Mechanical:

1. Service line penetrations into rooms shall be properly sealed with silicone caulking.
2. Insulate the supply and exhaust ducts for a minimum of 6 feet beyond the collar.

E. Provide carpentry supervisor and mechanical supervisor on job site whenever cold room installation in that area of work on rooms is taking place.

F. Manufacturer's Representative shall instruct Owner's staff in the operation of room including controls, after completion of room startup. The operating and maintenance manual shall indicate sequential operation, startup and shutdown, with all pertinent control data and schematics.

3.2 TESTING

A. Provide all equipment and instrumentation for testing and perform the specified tests.

B. Control Setpoint: Verify temperature control of plus or minus 0.5 degrees Celsius at the room sensor.

C. Temperature Uniformity: Measure temperature using a minimum of sixteen sensing points located at widely separated locations within the chamber to within 4 inches of chamber walls, 12 inches of the floor and 6 inches of the ceiling grid. The maximum allowable variation in temperature shall be 0.5 degrees Celsius and shall be measured by a multipoint strip chart recorder utilizing NIST traceable temperature sensors during a continuous 24 hour test period.

D. Temperature Gradient: Verify that maximum temperature gradient from floor to ceiling does not exceed 1.0 degrees Celsius.

E. Recovery Test: All rooms, except freezers, shall recover preset operating temperature within 5 minutes after door has been fully opened to 75 degrees Fahrenheit ambient for a period of 1 full minute.

F. Internal Load Test: Each room shall maintain plus or minus 1.0 degree Celsius control when operating with the number of people, amount of ventilation, and internal heat gain of lighting and equipment as shown on the Environmental Room Schedule.

G. Provide written reports, in duplicate, of all tests. Reports shall indicate procedures followed, instruments used, and tabulation of results.

H. Witnessing of Tests: Owner's Representative shall be given the option of witnessing and confirming test results. Notify Owner's Representative, in writing, 10 days prior to tests.

END OF SECTION 132100

SECTION 142000 - ELEVATORS

PART 1 - GENERAL

1.1 DESCRIPTION:

A. Related Documents: Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections apply to this Section.

B. Bidders Note:

1. The base bid shall be in accordance with the Construction Documents (Specifications and Drawings).

2. All clarifications, exceptions and qualifications to the Construction Documents will be considered as unsolicited alternates and must be submitted at bid time in the format of marking up this document to reflect your proposed product for this project.

3. Include all deductive pricing of the unsolicited alternates.

4. Mark-Up Architects Drawings to reflect any changes to dimensions to accommodate the base bid and any unsolicited deductive alternates.

5. Additional pages in letter form with regard to work by others or instructions to the contractor are acceptable, but all other clarifications to this document will be submitted with the bid as a mark-up of this document together with itemized pricing. The marked-up document when submitted will be reviewed, negotiated and will become a part of the Contract.

C. Work Included in This Section: Provide electric traction complete as shown and specified.

D. Related Work Interfaced With This Section:

1. Life Safety or Public Address Speakers: Furnished by others; wire from machine room to car, accommodations and installation in car canopy by this Section. Provide assistance with installation, hook-ups and testing at no additional cost to Owner.

2. Card Readers: Furnished by others; wire from machine room to car, interfacing with elevator controls and installation in elevator car by this Section. Provide assistance with installation, hook-ups and testing at no additional cost to Owner.

1.2 QUALITY ASSURANCE:

A. Qualifications of Bidders:

1. General: The entire elevator installation shall be manufactured, installed and maintained by an acceptable manufacturer listed or as qualified by addendum. No portion of the work shall be subcontracted unless qualified and accepted by addendum. Equipment proposed must have a history of successful operation under similar conditions for the last two (2) years.

2. Acceptable Bidders: One of the following or as approved by addendum. Those not listed must pre-qualify ten (10) days prior to bid date. Submit list of at least three (3) projects representing equivalent equipment that has been operational for at least two (2) years. Include Owner's name, person to contact and telephone number.

a. Fujitec Elevator Company.
b. KONE Elevator Company.
c. Mitsubishi Elevator Company.
d. Otis Elevator Company.
e. Schindler Elevator Company.
f. ThyssenKrupp Elevator Company.

3. Maintenance Qualifications: Performed by manufacturer installing elevator:

a. Show evidence of successful experience in complete maintenance of elevators.
b. Directly employ sufficient competent personnel within 50 miles of project to handle service.
c. Maintain local stock of parts adequate for replacement on permanent or emergency basis.
d. Respond to trouble calls within one hour.

e. Offer the Owner agreement for continuing maintenance after expiration of maintenance period under this contract.

4. Manufacturer's Qualifications: The design, engineering and manufacture of major elevator components such as machines, motors, motor drive units, controllers, door operators, safeties, governors, selectors, power units, etc. shall be from manufactures that have been in the business for the last ten years. Equipment proposed must have a history of successful operation under similar conditions for the last two (2) years.

5. Installer and Maintenance Qualifications: Installer must be a licensed Elevator Contractor in the State of California.

a. Show evidence of successful experience in complete installation and maintenance of proposed manufacturer's elevator equipment for at least two (2) years.
b. Directly employ sufficient competent personnel within 50 miles of project to handle construction and maintenance duties.
c. Maintain local stock of parts adequate for replacement on permanent or emergency basis.
d. Respond to trouble calls within one hour. 30 minutes.
e. Offer the Owner agreement for continuing maintenance after expiration of maintenance period under this contract.

B. Requirements of Regulatory Agencies:

1. Codes: In accordance with the latest applicable edition requirements of the following and as specified:

a. A.D.A.: Americans with Disabilities Act.
b. ASME: American Society of Mechanical Engineers - A17.1; Safety Code for Elevators and Escalators.
c. NFPA – 70
d. NFPA - 72
e. CBC: Title 24; California Building Codes.
f. CCR: Titles 8; California Code of Regulations.
g. All local codes, which govern.
h. All local administrative codes, which govern

1.3 Permits, Inspections, and Taxes:

1. Arrange and pay for inspections by governing authorities.
2. Obtain and post operating permits per applicable code.
3. Arrange and pay for all applicable taxes.

1.4 Definitions:

A. Main Lobby: Ground Level unless otherwise indicated.

B. Fire Recall Level: As directed by local fire authority.

C. Alternate Fire Recall Level: As directed by local fire authority.

D. Serviceability: It is recognized that each manufacturers system contains components that are proprietary to the development of their systems. The Owner may wish to have the elevator system maintained by another technically qualified service provider and by submitting a bid for this project, the manufacturer shall guarantee that for a minimum of 20 years they will provide the following:

1. Diagnostic, adjusting and monitoring tools for all components including documents, manuals, wiring diagrams and spare parts as listed in Part 3 of this specification shall be provided in each machine room, controller room or machine space as a permanent part of the installation and become the property of the Owner. Devices shall be permanent at no additional cost to Owner, shall not self-destruct, require charging or exchange. Remote monitoring devices are excluded from this requirement, however if such devices are removed all wiring shall be neatly terminated, tied within a junction box and properly marked as to its content.

2. Manufacturer shall guarantee to support the equipment for this project with regard to notification to Owner of system corrective updates, provide and install such updates at no cost to Owner.

3. Provide contact information for their separate parts warehouse so that the Owner or designated service provider can order parts on a 24 hour basis and delivered with 48 hours.

4. Provide a list of parts of each component manufactured and stored at the warehouse and the retail cost of each at close out of the project and estimated escalation cost. The cost of these parts is what would be charged to Owner or other service provider.

5. Provide contact information for technical support so that the Owner or designated service provider can obtain technical support on a 24 hour basis to provide assistance in trouble shooting problems. Indicate hourly rate charged to Owner or designated service provider for such service.

6. In the event that a company other than Contractor maintains the elevators, and if the equipment was unable to be repaired by the maintenance company, a factory-trained technician would be required to assist (as it would if Contractor's own technician were in the same situation). If such an event was to occur, Contractor would make its factory-trained technician available for assistance upon request of the Owner within three (3) business days, based on the contractual hourly rates subject to established annual escalations.

7. The above will survive any termination of the maintenance agreement.

1.5 SUBMITTALS:

A. Shop Drawings: Submit as required by the Owner's Representative. The Owner's Representative reserves the right to require any details of any portion of the equipment.

1. Layouts: Plan and section of hoistways, pits and machinery spaces; include impact and static loads imposed on building structure location of hoistway ventilation and required clearances around equipment.
2. Details: Submit details of cabs, fixtures and entrances.
3. Data: Indicate on layouts or separate data sheets; machine spaces heat release, power requirements, and normal annual power consumption, conduit runs outside of hoistways and machine rooms, car and counterweight roller guides and door operators.

B. Samples: Provide samples of materials and finishes exposed to public view and additional, if specifically requested, 6 inch x 6 inch panels, 12 inch lengths or full size if smaller, as applicable.

C. Operating Instructions: Submit manufacturer's literature describing system operations and special operations as specified.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Protect equipment during transportation, erection and construction. Store under cover to prevent damage due to weather conditions. Replace damaged materials.

1.7 SEQUENCING AND SCHEDULING:

A. Schedule and be responsible for coordinating related work with other trades to avoid omissions and delays in job progress.

1.8 WARRANTY:

A. Provide special project warranty, signed by Contractor, Installer and Manufacturer, agreeing to replace/repair/restore defective materials and workmanship of elevator work which may develop within one (1) year from final date of completion and acceptance of the entire installation. "Defective" is hereby defined to include, but not by way of limitation, operation or control system failures, performances below required minimums, excessive wear, unusual deterioration or aging of materials or finishes, unsafe conditions, the need for excessive maintenance, abnormal noise or vibration and similar unusual, unexpected and unsatisfactory conditions.

1.9 ALTERNATES:

A. Alternate No. 1; Continuing Full Maintenance Contract:

1. Submit per OEM standard maintenance agreement denoting maintenance hours per month, cost per unit per month. Hours of operation, Maintenance Control Program (MCP) chart denoting process and procedures.

2. Quote cost and submit manufacturer's proposal for full maintenance contract for a period of five (5) years after expiration of 12-month warranty maintenance provided with this new installation.

   a. 12 Month Warranty Maintenance Cost: $_____

   b. 60 Month / 5 Year Continuing Maintenance Cost (w/o) Escalations: $_____

3. Provide examinations, lubrication and replacements in accordance with manufacturer's standard practice. Include frequency and hours as indicated under Maintenance in Part 3 of this specification. Any work required performing repairs or answering trouble calls shall be in addition to the preventative maintenance hours.

4. Provide 24-hour emergency call back service.

   a. Any callback associated with entrapments is at no cost to Owner; 24 hours per day.

   b. Trouble callbacks during normal working hours are at no cost to Owner.

   c. Non-Entrapment callbacks after hours shall be billable for the premium time portion only.

PART 2 - PRODUCTS:

2.1 DESCRIPTION OF SYSTEMS:

A. Elevator No.PE1; Passenger: Front and Rear Opening

1.	Type:	Gearless Machine Room-less Traction
2.	Product:	Over Slung / Self-Supporting / Underslung
3.	Capacity:	3500 Pounds
4.	Speed:	400 FPM
5.	Stops:	6 at Warehouse,1,Mezz,2,3,4
6.	Openings:	6 (Front at W,M,2-4; Rear at 1)
7.	Travel:	As Shown
8.	Control:	AC/VVVF - REGEN
9.	Operation:	DD with SE1
10.	Machine Location:	Within Top of Hoistway
11.	Compensation:	As Required By Manufacturer
12.	Special Operations:	
	a. Independent Service	
	b. Fire Emergency Service	
	c. Standby Emergency Power	
	d. Battery Rescue Units (if no EP)	
	e. Anti-Nuisance Service	
	f. Tenant Security	
	g. Seismic Operation	
13.	Car Enclosure Type:	Passenger
	a. Platform Size	7'-0" W by 6'-7" D by 10'-0" H
	b. Inside Clear	6'-8" W by 5'-5" D by 9'-0" H
14.	Signals and Fixtures	Design as Specified
	a. Car Operating Panels	2 Per Car; Swing
	b. Car Position Indicator	Integral with Each Car Panel
	c. Communication Sys.	Integral with Car Panel
	d. Service Cabinet	Integral with Car Panel
	e. Hall Pushbuttons	2 Risers (F/R)
	f. Hall Lanterns	All Floors
	g. Hall Pos. Indicators	Main Floor
	h. Faceplate Finish:	Stainless Steel
	i. Faceplate Fastening	Tamper Proof

15. Passenger Entrance Type — Center Open, Single Speed

    a. Size — 3'-6" W by 8'-0" H
    b. Frames
        1) Main Floor — Stainless Steel
        2) Typical Floors — Stainless Steel
    c. Doors
        1) Main Floor — Stainless Steel
        2) Typical Floors — Stainless Steel
    d. Sills
        1) Main Floor — Aluminum
        2) Typical Floors — Aluminum

16. Miscellaneous Items:

    a. Disabled Access Requirements
    b. Key Operated Hoistway Access
    c. Seismic Requirements
    d. Card Reader Provisions
    e. CCTV Provisions

B. Elevator No. SE1 Service: Front Opening

1. Type: — Gearless Machine Room-less Traction
2. Product: — Over Slung
3. Capacity: — 5000 Pounds
4. Speed: — FPM
5. Stops: — 5 at Warehouse,Mezz,2,3,4
6. Openings: — 5 In Line
7. Travel: — As Shown
8. Control: — AC/VVVF - REGEN
9. Operation: — DD with PE1
10. Machine Location: — Within Top of Hoistway
11. Compensation: — As Required By Manufacturer
12. Special Operations:

    a. Independent Service
    b. Fire Emergency Service
    c. Standby Emergency Power
    d. Battery Rescue Units (if no EP)
    e. Anti-Nuisance Service
    f. Tenant Security
    g. Swing Service
    h. Seismic Operation

13. Car Enclosure Type: — Service / 5WL Patterned Stainless Steel

    a. Platform Size — 6'-0" W by 9'-5" D by 10'-0" H
    b. Inside Clear — 6'-8" W by 8'-6" D by 10'-0" H

14. Signals and Fixtures — Design as Specified

    a. Car Operating Panels — 1 Per Car; Applied Type
    b. Car Position Indicator — Integral with Each Car Panel
    c. Communication Sys. — Integral with Car Panel
    d. Service Cabinet — Integral with Car Panel
    e. Hall Pushbuttons — 1 Riser
    f. Hall Lanterns — All Floors
    g. Hall Pos. Indicators — Main Floor
    h. Faceplate Finish: — Stainless Steel

15. Faceplate Fastening — Tamper Proof Matching Faceplate

16. Passenger Entrance Type — Side Open, Two Speed

    a. Size — 4’-0” W by 8’-0” H
    b. Frames
        1) Main Floor — Stainless Steel
        2) Typical Floors — Stainless Steel
    c. Doors
        1) Main Floor — Stainless Steel
        2) Typical Floors — Stainless Steel
    d. Sills
        1) Main Floor — Aluminum
        2) Typical Floors — Aluminum

17. Miscellaneous Items:

    a. Disabled Access Requirements
    b. Key Operated Hoistway Access
    c. Seismic Requirements
    d. Card Reader Provisions
    e. CCTV Provisions

C. Elevator No.PE3; Passenger: Front Opening

1. Type: — Gearless Machine Room-less Traction
2. Product: — Over Slung
3. Capacity: — 3500 Pounds
4. Speed: — 400 FPM
5. Stops: — 4 at 1,2,3,4
6. Openings: — 4 In Line
7. Travel: — As Shown
8. Control: — AC/VVVF - REGEN
9. Operation: — Simplex Operation
10. Machine Location: — Within Top of Hoistway
11. Compensation: — As Required By Manufacturer
12. Special Operations:
    a. Independent Service
    b. Fire Emergency Service
    c. Standby Emergency Power
    d. Battery Rescue Units
    e. Anti-Nuisance Service
    f. Tenant Security
    g. Seismic Operation
13. Car Enclosure Type: — Passenger
    a. Platform Size — 7’-0” W by 6’-2” D by 9’-6” H
    b. Inside Clear — 6’-8” W by 5’-5” D by 9’-0” H
14. Signals and Fixtures — Design as Specified
    a. Car Operating Panels — 2 Per Car; Swing
    b. Car Position Indicator — Integral with Each Car Panel
    c. Communication Sys. — Integral with Car Panel
    d. Service Cabinet — Integral with Car Panel
    e. Hall Pushbuttons — 1 Risers 1
    f. Hall Lanterns — All Floors
    g. Hall Pos. Indicators — Main Floor
    h. Faceplate Finish: — Stainless Steel
    i. Faceplate Fastening — Tamper Proof

15. Passenger Entrance Type — Center Open, Single Speed

    a. Size — 3'-6" W by 7'-0" H
    b. Frames
        1) Main Floor — Stainless Steel
        2) Typical Floors — Stainless Steel
    c. Doors
        1) Main Floor — Stainless Steel
        2) Typical Floors — Stainless Steel
    d. Sills
        1) Main Floor — Aluminum
        2) Typical Floors — Aluminum

16. Miscellaneous Items:

    a. Disabled Access Requirements
    b. Key Operated Hoistway Access
    c. Seismic Requirements
    d. Card Reader Provisions
    e. CCTV Provisions

2.2 MATERIALS:

A. Aluminum: Alloy and temper best suited for anodizing finish specified.

B. Bronze: CDA Alloy 280, muntz metal.

C. Glass: Laminated Safety Glass meeting ANSI Z97.1.

D. Nickel Silver: CDA Alloy 796, leaded nickel silver.

E. Plywood: PS-1, A-D exterior Grade Douglas Fir, fire retardant treated.

F. Sheet Steel: ASTM A366, uncoated, pickled, free from defects.

G. Sound Deadener: Fire retardant; spray, roller or adhesive applied; 3/16 inch thick.

H. Stainless Steel: ASTM A167; type 302 or 304.

2.3 FINISHES:

A. Exposed-to-View Surfaces. Provide as follows unless otherwise specified.

1. Aluminum: Clear anodized finish.
2. Sheet Steel:
    a. Shop Prime: Degrease clean of foreign substances and apply one coat of corrosion inhibiting primer compatible with finish paint selected. Hoistway items visible to public shall be painted one additional coat of black paint.
    b. Finish Paint: Factory applied baked enamel or powder coat; color as selected.
3. Stainless Steel:
    a. Plain: Satin, No. 4 finish unless otherwise specified
    b. Patterned: Rigidized Metal's No. 5 WL, RIMEX Metals No. 5-SM or equal.
4. Touch-Up:
    a. Prime Surfaces: Use same paint as factory for field touch-up.
    b. Finish Painted Surfaces: Refinish whole panel with shop prime and finish paint as specified above.

B. Non-Exposed-to-View Surfaces: Degrease and shop paint manufacturer's standard corrosion inhibiting primer.

C. Paint and Corrosion Protection: Equipment shall have the following minimum corrosion protection:

1. All steel parts shall be sandblasted in accordance with SSPC and painted with a rust inhibiting primer coat.

2. Steel parts which are not specified to be galvanized shall be painted with a 1) first finish of two (2) mil dry film thickness and 2) a second finish coat of two (2) mil dry film thickness.

2.4 AUTOMATIC OPERATION:

A. General Operation of Individual Elevators:

1. Provide a non-proprietary microprocessor-controlled dispatching system designed to monitor all types of traffic and sufficiently flexible so that it can be modified to accommodate changes in traffic patterns. Include hardware necessary to protect hoist motors, motor drives and door operators. Software shall control group and simplex program operations.
2. The system shall continuously monitor the demand based on real time calculations to assign and reassign the elevators to handle the traffic in the most efficient manner.
3. Provide "anti-nuisance service" whereby all car calls will be cancelled if the load-weighing device detects that an abnormal number of calls are registered given the number of passengers in the car. System using false call answering to accomplish this is not acceptable.
4. Serial Link Communications: Provide a distributed processing network consisting of localized processors located in machine rooms, car stations, hall stations and top of car to allow system to make fast decisions based on data shared by the processor involved in the different operations of the elevators. For group dispatch operations, all elevators in the group shall be capable of acting as a group common dispatcher as the need arises.
5. Fault Diagnostic System: Provide Owner with all hardware such as on-board LED. Diagnostics, hand held device or laptop computer, as standard with manufacturer, and supporting software documentation. Diagnostic system shall be capable of determining faults most difficult to find.

B. Group Destination Entry Control Operation: (PE1 & SE1)

1. Provide a hall registration control system arranged to enter floor destination through lobby Keypad or Touch Screen type fixtures. Provide a system algorithm that will assign registered floor demands to car which will provide the best passenger time to destination or alternatively the shortest waiting time which will vary throughout the day depending on the particular peak traffic demand. Car assignment and response time determined by computing relative factors such as distance, service to previously assigned car and hall calls, car load, direction, door and car motion status, and coincidence of car and hall calls. Continuously compute these factors and assign best car available to answer call.
2. System shall group passengers to elevator(s) by their common input selected destination floor information. Call allocation shall minimize the amount of stops performed by the elevator.
3. Provide variable algorithm based control system with remote keypad/intuitive touch screen at entrance(s) to building location as selected by Owner's Representative. Upon passenger entering floor selection onto keypad/touch screen system shall, via integral display, instantly indicate elevator (A-B-C-D, 1-2-3-4, etc) designated for each passenger upon registering of selected floor destination.
4. Remote keypad/intuitive touch screen shall employ an international wheelchair symbol to activate special features for people with special needs. Upon activation of wheelchair symbol, provide both visual and/or audible responses. Provide that the elevator assigned to persons with special needs will have fewer passengers to allow extra room in elevator cab. Provide extended door open time to allow passenger extra time to enter and exit elevator. Provide audible tones and/or voice communication to indicate elevator assigned, elevator location, status of doors and arrival at destination floor to assist special need passengers throughout their journey.
5. Provide call correction in the event of misuse, abuse or neglect, a single passenger places numerous calls or fails to enter elevator designated, elevator car load weighers shall detect weight of passenger and correct automatically. In the event there is a single call place and numerous passengers enter elevator, system shall monitor and allow for making corrections automatically in algorithm based logic.
6. Early car announcement shall not exceed 10 seconds if implemented.
7. ETD algorithm shall apply a common approach to both conventional up/down hall calls, and destination calls, allowing both to be used in the same system. Intermediate hall calls shall be calculated with corresponding car calls. Hall call shall be interfered or assigned as a car call to eliminate SDF (System Degradation Factor). As hall call ages it shall receive additional priority to eliminate long wait calls.
8. Provide two touch screen and keypads at the main floor to be mounted at the east and west ends of the main floor lobby. These shall have a minimum of a 15" touch screen monitor, key pad, and card reader cutout with lenses. They shall be capable of providing global dispatching at their location.

9. Provide two touch screen and keypads per group at the main floor to be mounted in the elevator lobbies.
10. Provide two touch screen and keypads per group per typical floor to be mounted in the elevator lobbies.
11. Provide active hall lanterns on all elevators.
12. Provide accessibility for fully integrating system into planned security system at Owner's Representative's direction.
13. Provide options for floor selection destination input devices to Owner's Representative, but not limited to keypad, intuitive screen, security card swipe, PIN number registration, special keys and hands free radio tag devices.

14. Destination Entry Car Operating Panel and Floor Indicator Panel:

    a. Provide concealed car operating panel. One required per elevator. Operating buttons shall be utilized for Emergency Services and for Maintenance.
    b. Provide destination floor indicator panel and upon entering elevator passenger shall note their destination floor is illuminated, Upon arrival at destination floor, the floor number on indicator destination panel flashes to confirm their arrival.

C. Simplex Selective Collective Operation: Provide a microprocessor-based control system to perform functions of elevator motion, car operation dispatching and door control.

1. Arrange for Simplex Selective Collective automatic operation. Operate elevators from a single riser of landing buttons and from operating device in car.
2. Momentary pressure of one or more car or landing buttons, other than those for landing at which car is standing, starts car, and causes car to stop at first landing for which a car or landing call is registered corresponding to direction in which car is traveling. Stops made in order in which landings are reached, irrespective of sequence in which calls are registered.
3. Double door operation not permitted. If an up traveling car has a passenger for an intermediate floor and a down call is registered at that floor, with no calls above car, it travels to floor, opens door to let passenger out, then lights down direction arrow in hall lantern and accepts waiting passenger without closing and reopening doors.

D. Simplex Selective Collective Operation: Provide a microprocessor-based control system to perform functions of elevator motion, car operation dispatching and door control.

1. Arrange for Simplex Selective Collective automatic operation. Operate elevators from a single riser of landing buttons and from operating device in car.
2. Momentary pressure of one or more car or landing buttons, other than those for landing at which car is standing, starts car, and causes car to stop at first landing for which a car or landing call is registered corresponding to direction in which car is traveling. Stops made in order in which landings are reached, irrespective of sequence in which calls are registered.
3. Double door operation not permitted. If an up traveling car has a passenger for an intermediate floor and a down call is registered at that floor, with no calls above car, it travels to floor, opens door to let passenger out, then lights down direction arrow in hall lantern and accepts waiting passenger without closing and reopening doors.

2.5 SPECIAL OPERATIONS:

A. Inspection Operation: Provide key-operated hoistway access device and car top operating device. Key switches shall be mounted in doorframes with only ferrule exposed at terminal landings. Incorporate access switches in hall button stations for freight elevators.

B. Independent Service: Independent service operation shall be provided so that, by means of a switch located in the car service cabinet, the car can be removed from automatic operation and be operated by an attendant. The attendant shall have full control of the starting, stopping and direction of car travel. The car shall respond to car buttons only. The hall signals for the car on independent service shall not operate.

C. Operation Under Fire or Other Emergency Conditions: Provide special emergency service to comply with ASME A17.1, CCR Title 8and local codes having jurisdiction. Provide Phase 1 recall switch at Main Floor Elevator Lobby. Key switches at main floor shall be integrated in hall button station with engraved instructions.

D. Operation Under Earthquake Conditions: Provide seismic operation in accordance with ASME A17.1. Provide a dual ring and string, continuously monitoring type counterweight displacement device for each counterweight with rings mounted on diagonal corners of frame. Provide a seismic switch device measuring both horizontal and vertical accelerations for each group of elevators located per manufacturer's recommendations.

E. Operation Under Emergency Power System:

1. General: The standby power system is sized to operate one elevator in each group simultaneously. Elevators shall be grouped as follows:
2. Group 1 = Elevators No. PE1 & SE1
3. Group 2 = Elevators No. PE3

    a. When normal power fails and standby power becomes available, a signal will be given to the controllers, all elevators will shut down, and all car lights, etc., will be extinguished.
    b. When emergency power comes onto the line, power for lighting car fan and alarm bell shall be automatically transferred and all cars on automatic operation shall be sequentially returned one at a time from each group, to the main floor.
    c. After all cars are parked at main floor, one car of each group shall resume normal operation.
    d. Provide interlocking illuminated strip switches to permit manual selection of desired elevator to operate on emergency power.
    e. When normal power fails and emergency power is used, or when normal power is restored, the Elevator Manufacturer shall provide all circuitry necessary, including time delay or auxiliary relays required to accomplish safe, continuous elevator operation. The cars will start in sequence, not simultaneously; allow 10 seconds between starts.
    f. Fire service and derailment devices shall be operable when system is on emergency power operation.

F. Battery Rescue Unit: Traction

1. When power is lost in a building, the unit will disconnect the elevator system from the building power source. It will then power up its inverter and provide battery generated three (3) phase power to the elevator controller. At this time, it will also provide a signal (dry contact) to the elevator controller to tell it that it is on battery power.
2. The elevator controller reads this signal and then initiates an “automatic rescue operation”. First the elevator controller reads the load weigh sensor (or does a floor hold operation and reads the direction of the drive’s torque) and determines the “overhauling” direction for the elevator: empty car up, fully loaded car down, and if a balanced car is sensed then the direction normally will be down, except during seismic operation. Next the elevator controller moves the elevator to the next available floor at rescue speed (inspection or leveling speed) in the “overhauling” direction. This is done with the elevator’s variable speed drive controlling the elevator’s speed with all safeties intact. Once the elevator reaches the next available floor, it will level into the door zone. It will then perform a normal door open, wait a set period of time for passengers to exit, and then a normal door close.
3. When normal power returns, the elevator is reconnected to normal building power and resumes normal operation.

G. Tenant Security: means in control system to enable and disable car call buttons as follows:

1. Function, which locks out all cars in a group so that all car buttons are inoperative, except the main floor.
2. Function which locks out any selected car button for all elevators in a group serving that floor.
3. Tenant security operations can be overridden by cars on independent, any special emergency service or by card reader access.

H. Swing Service Operation; Elevator No.SE1: Through the Guard Engineers CRT and Keyboard Control station, provide a function to place elevator on swing service operation.

1. Activation of function removes car from group operation and places it on simplex selective collective operation, controlled by normal car buttons and a separate inconspicuous riser of hall buttons.
2. Swing service operation shall not effect cars on independent or fire emergency service.
3. Provide a key switch or card reader input in each inconspicuous riser station to allow operation of the buttons.

2.6 DOOR OPERATION:

A. Passenger Type Horizontal Sliding:

1. Door Operator: Provide heavy-duty master type operators with AC motor. Provide closed-loop door operators.

a. Provide door performance times as specified under "Design Criteria".
b. Car and hoistway doors shall open and close simultaneously, quietly and smoothly; door movement shall be cushioned at both limits of travel. Door operation shall not cause car enclosures to move.
c. Door hold open times shall be readily and independently adjustable when car stops for a car or hall call. Main floor door hold times shall be adjustable independent of other floors.
d. Hangers and Tracks: Sheave type with two-point suspension. Steel sheaves with flanged groove and resilient sound-absorbing tires. Minimum 2-1/2 inch diameter for hoistway, 3 inch for car. Provide manufacturer's heavy-duty tracks and ball or roller bearings with adjustable up thrusts.

B. Door Protection; Passenger Type:

1. Electronic Scanning Type:

a. Provide a door protective system, which does not rely on physical contact with a person or object to inhibit door movement or initiate door reversal.
b. The system shall be able to detect a 2-inch diameter rod introduced at any position within the door movement and between the height of 2 inches and 63 inches above sill level.
c. Detection of intrusion into the protected area shall cause the doors, if fully open, to be held in the open position and, if closing, to reverse to fully open position.
d. If doors are prevented from closing for an adjustable period of 15 to 45 seconds or upon activation of Fire Emergency Service, they shall proceed to close at reduced speed and a loud buzzer shall sound. Door closing force shall not exceed 2-1/2 ft.-lbs. when door re-opening device is not in operation.
e. For side-opening doors, the detector for the strike jamb side shall be recessed, flush with strike jamb.

2. Door Hold Button; Service Elevator SE1: Provide an illuminated door hold button, operation of which will hold the doors open for a predetermined and adjustable period of 20 to 90 seconds. Sound warning buzzer 5 seconds prior to expiration of time. Normal operation shall be resumed upon:

a. Expiration of door hold time.
b. Operation of door close button in car.
c. Operation of any floor button in car.

C. Interlocks: Equip each hoistway door with a tamper-proof interlock, which shall prevent operation of the car until doors are locked in the close position as defined by the Code. Interlock shall prevent opening of doors at landing from corridor side unless car is at rest at landing, is traveling through leveling zone or, hoistway access switch is used. Interlocks shall lock the two door sections together.

2.7 SIGNALS AND OPERATING FIXTURES:

A. General: Provide signals and fixtures as shown and specified. Location and arrangement of fixtures shall comply with disabled access requirements.

1. Buttons: Operation of car or hall button shall cause button to illuminate. Response of car to car or hall call shall cause corresponding button to extinguish.

a. Passenger Elevator Buttons: Provide minimum 1-inch diameter mechanical, white illuminated buttons with engraved identifications. Buttons shall be raised 1/8 inch from surrounding surface with square shoulders.
b. Service Elevator Buttons: Provide vandal-resistant stainless steel minimum 1 inch diameter mechanical buttons with integral illumination. Buttons shall be raised 1/8 inch from surrounding surface with square shoulders. Operation of car or hall button shall cause button to illuminate.

2. Switches: Toggle type typically or key operated where noted.

3. Faceplates: Provide of material and finish as scheduled; 1/8 inch minimum thickness with sharp edges relieved.

4. Fastenings: Provide as scheduled.

5. Cabinets: Provide with pulls, concealed hinges and doors mounted flush with hairline joints to adjacent surface.

6. Arrangement: Arrangement of fixtures shall generally conform to that specified, but components may be rearranged, if desired, subject to Owner's Representative's approval.

7. Engraving: Of size indicated; color backfill with epoxy paint in contrasting color as selected.

8. Lamps: Miniature LED type.

9. Audible Chimes: Electronic adjustable audible chimes; bell type gong not acceptable.

10. Provide floor passing signal of the adjustable electronic audible chime type.

11. Provide Audible Indicator's (CA: 11B – 407. 4.8.2.1: The signal shall be an automatic annunciators which announces the floor at which the car is about to stop. Signal Level (CA: 11B – 407.4.8.2.2 shall be 10Db minimum above the ambient, but shall not exceed 80dB, measured at the annunciator, the annunciator shall have a frequency of 300Hz minimum to 3000 Hz maximum.

12. Tactile Markings: Provide raised Braille and alpha characters, numerals or symbols adjacent to operating buttons and devices used by the public according to local codes. Indications may be engraved directly on faceplates or separate plates flush mounted with hairline joints and concealed mechanical fasteners. Plates shall be of same size and shape as buttons or integral "fishtail" type.

B. Car Operating Panels:

1. General: Provide buttons identified to conform to floors served and the following:

   a. Locate top operating button at 48 inches above floor; maximum 54 inches when required depending on floors served.
   b. Locate emergency stop and illuminated alarm button in bottom row at 35 inches above floor. Wire emergency stop to ring alarm bell.
   c. Provide door operating buttons located above emergency stop and alarm of same design as car button.
   d. Engrave main panel with capacity, number of passengers and elevator number per code. Engrave auxiliary panel with NO SMOKING in 1/2-inch letters. All other signage required by local codes shall be engraved as directed by Owner's representative.
   e. Provide fire emergency panel above floor buttons containing phase II fire key switch, call cancel button stop switch, door open, door close buttons, audible/visual signals and instructions.
   f. Make provisions for card readers as scheduled. .

2. Swing Type: Integrate cabinets, buttons and engraving into swing front return panels without applied faceplate. Entire front return shall swing on concealed hinges with concealed locking means for servicing.

3. Applied Type: Integrate cabinets, buttons and engraving into hinge single piece faceplate mounted to front return panel or on sidewall adjacent to strike jamb.

C. Car Position Indicators:

1. Provide car position indicators with indications corresponding to floor designations with matching direction arrows and floor passing chimes or verbal annunciator which announces the floor at which the car is about to stop. Provide manufacturers standard designation for elevators with express zones.

   a. Digital Type: Provide direct readout indicator with minimum one-inch high indications mounted integral with each car-operating panel.

D. Hall Position Indicators: Provide digital type position indicators with 2" high indications corresponding to floor designations located in lobby as directed by Owner's Representative. Combine with hall lanterns.

E. Service Cabinet: Provide cabinet door with a lock and concealed hinge as an integral part of car operating panel mounted with flush hairline joints. Cabinet door shall be provided with a flush glazed window of required size to hold elevator-operating permit. Service cabinet shall contain the following:

1. Independent service switch.
2. Two-speed ventilation switch.
3. Light switch or dimmer as applicable.
4. Inspection switch, key operated.
5. Duplex convenience outlet.
6. Buzzers as required.
7. Constant pressure test switch for emergency car lighting.
8. Card reader over-ride switch.

F. Passenger Emergency Communication Speaker Phone: Provide a complete communication system in compliance with A.D.A. regulations and local codes consisting of a combination speaker/microphone, amplifier, automatic dialer with 4 number rollover capability and matching car station push button with telephone symbol to activate system and call-acknowledgement lights. Mount speaker behind a pattern of holes as selected as an integral part of car operating panel. Wire to machine room and program automatic dialer as directed by Owner.

G. Hall Button Fixtures: Each fixture shall contain buttons, which light to indicate hall call registration and extinguish when call is answered.

1. Engrave "Fire Exiting Pictograph per CBC 3002.3, provide engraved Phase I "Fireman's Operating Instructions" on Main recall hall pushbutton faceplate.

H. Hall Lanterns: Provide with single chime hat sounds once for up and chime twice for down direction. (CA. 11B – 407.2.2.2 shall be located at 72 inches minimum above the finish floor or ground.) (Or shall be provided with verbal annunciator's with a frequency of 300 Hz minimum and 3000 Hz maximum). Lantern illuminates white for up and red for down. As car approaches floor, lantern shall illuminate and chime approximately 4 seconds prior to doors opening to indicate next direction of travel.

1. Hall Lanterns shall be provided with a programmable auditory volume level module or means to regulate the auditory volume of chime.

I. (CA. 11B – 407.2.2.3) Auditory volume shall have a frequency of 1500 Hz, be at least 10dB above ambient sound level, but shall not exceed 80 dB, measured 36 at the hall call button. (Or shall be provided with verbal annunciator's with a frequency of 300 Hz minimum and 3000 Hz maximum)

J. Provide hall lanterns with matching hall button stations faceplates.

1. Provide special design lanterns as detailed on drawings.

2. Guard's Control Station: Locate as directed. Include the following devices for each elevator or group of elevators as applicable.

   a. Display showing status, position and direction of each elevator.
   b. Function to call and shut down each car at lobby with doors closed.
   c. Function to place cars on independent service operation and call car to lobby and park with doors open.
   d. Function for tenant security operation as specified under Special Operations.
   e. Function for swing servic operation as specified under Special Operations.
   f. Function for Emergency Power selection and display indicating which cars are on standby emergency power.
   g. Building Emergency Personnel Communication System with instructions.

3. Life Safety Control Station: Locate in Fire Control Room as indicated; size panel to suit space available and design as approved. Include the following for each elevator or group of elevators as applicable.

   a. Display showing status position and direction of each elevator.
   b. Three-position fire key switch with visual indication. Interlock with lobby key switch to prevent simultaneous activation.

c. Function for Emergency Power selection and display indicating which cars are on standby emergency power.
d. A compartment containing properly identified keys to operate all fire service switches. Provide tags with legible instructions on each key. Lock on compartment shall be subject to house master key or fire department key per local codes.
e. Building Emergency Personnel Communication System with instructions.

2.8 WIRING:

A. General: Provide all necessary wiring with 25% or a minimum of four spares between cars and controllers and to all remote control stations. Furnish shielded wires in cables for all communication systems card readers digital display devices and speakers. Include two additional pairs of shielded spares for each car.

B. Traveling Cables: Use minimum number of traveling cables with flame retarding and moisture resisting covers. Include shielded wires and spares as noted above. Cord thoroughly and protect cables from rubbing against hoistways or car items. Provide with steel cable core and properly anchored to relieve strain on individual conductors.

C. Work Light and Convenience Outlet: Provide on top of car with wire lamp guard.

D. Stop Switch: Provide in each pit and on top of car.

E. Alarm Gong: Six-inch size, 110 volt. Provide on top of each car to be actuated by corresponding alarm button or emergency stop switch.

F. Auxiliary Disconnect Switches: Provide as required in remote controller rooms or at remote equipment not in view of mainline switches; include all wiring and conduit.

G. Coaxial Circuit: Provide for closed circuit television camera in elevators. Run from elevator car to machine room.

2.9 CAR ENCLOSURES:

A. General: Fabricate finish work smooth and free from warps, buckles, squeaks and rattles; joints lightproof. Car shall be sound isolated from car frame. Apply sound deadener on outside of car shell. No visible fastenings, except as indicated.

B. Passenger Cars; Elevator No. PE1 & PE3

1. Steel Shell: Fabricate walls of 14-gauge sheet steel from floor to canopy. Canopy 12 gauge reinforced. Paint shell in color as selected by Owner's Representative.

2. Emergency Exit: Top of car per code.

3. Ventilation: Minimum two-speed squirrel cage exhaust blower: Low Speed 399 CFM with maximum 50 dBA sound level; High Speed 613 CFM with maximum 60 dBA sound level. Provide sound isolation mounting on canopy. Provide concealed vents at base and ceiling as required by code.

4. Car Doors: Fabricate from 16-gauge sheet steel on front and back of each panel sufficiently reinforced with steel to insure rigidity. Provide two guides per panel located one inch from each end. Provide full-length neoprene astragals. Finish car side with satin finish stainless steel and return finish 1/2 inch around edge of doors. Door strength and locking means shall comply with code where hoistway fascia is not provided directly in front of car doors.

5. Protective Pads: Provide one set of heavy quilted protection pads for each group of elevators. Pads shall cover all walls with cut-out sections for car operating panels. Provide pads with rubber-coated 'J' type hooks sewn into top of pad for mounting on top of removable panels where panels are provided, otherwise pad buttons matching other metal finishes within the car shall be provided.

6. Front Return Panels: Provide full integral swing type for PE1 & PE3 front return panels fabricated from 14 gauge stainless steel.

7. Interior Panels, Ceiling, Lighting, Handrail, Flooring and Special Trim as indicated on drawings covered under dollar allowance. Design elevator system to accommodate an interior finish weight of 800 pounds. Refer to architect’s drawings for cab interiors.

8. Base and Metal Trim: Provide base below removable panels, vertical joints between panels and other metal fabricated from stainless.

9. Ceiling and Lighting: Provide Motion Sensor: Upon 10 seconds of no activity or motion within elevator cab interior sensor shall render the cab lights inoperative. Upon movement of car doors or any additional movement within elevator cab or elevator components, sensor shall activate car lighting.

10. Handrail: Provide handrails on rear wall PE3 and side walls PE1 with radius corners turning back into cab wall panel. Fabricate from 1-1/2 inch diameter stainless steel with matching brackets. Securely attached to car shell with concealed fasteners. Refer to architects drawings for cab interiors.

11. Support Rails: CA: 11B – 407.4.10: Support rails shall be provided on at least one wall of the car.

    a. CA: 11B – 407.4.10.1: Clearances between support rails and adjacent surfaces shall be 1 ½ in. minimum with top of support rail at 31 in. to 33 in. maximum above the floor of the car. The ends of the support rail shall be 6 in. maximum from adjacent walls.

    b. CA: 11B – 407.4.10.3: Allowable stresses shall not be exceeded for materials used when a vertical or horizontal force is 250 lbs. is applied to any point on the support, fasteners, mounting devices or supporting structure.

12. Sills: Provide extruded aluminum threshold plate. Mount with concealed mechanical fasteners. Allow for installation of finish flooring.

13. Finish Flooring: Provided by others.

C. Service/Passenger Cars; Elevator No. SE1:

1. Steel Shell: Fabricate walls of 14 gauge patterned 5WL stainless steel. Extend from floor to canopy and heavily reinforce to withstand severe service.

2. Canopy: 12 gauge reinforced baked enamel paint.

3. Lighting: Provide LED type light fixtures recessed in canopy with bottom of fixtures flush with underside of ceiling. Provide with hinged protective diffuser. Protect boxes on car top against damage and ventilate adequately. Light level shall average 20 foot-candles on the floor.

4. Emergency Exit: Top of car per code.

5. Car Doors: Fabricate from 16-gauge sheet steel on front and back of each panel sufficiently reinforced with steel to insure rigidity and sound deadened. Provide two guides per panel located one inch from each end. Provide full-length neoprene astragals. Finish car side with 5WL vandal resistant patterned and return finish 1/2 inch around edge of doors. Door strength and locking means shall comply with code where hoistway fascia is not provided directly in front of car doors.

6. Front Return: Provide fixed type front return panels fabricated from 14 gauge stainless steel.

7. Ventilation: Minimum two-speed squirrel cage exhaust blower: Low Speed 399 CFM with maximum 50 dBA sound level; High Speed 613 CFM with maximum 60 dBA sound level. Provide sound isolation mounting on canopy. Provide concealed vents at base and ceiling as required by code.

8. Handrail: Provide handrails on rear and side walls with radius corners turning back into cab wall panel. Fabricate from 1-1/2 inch diameter stainless steel bronze with matching brackets. Securely attached to car shell with concealed fasteners.

9. Sills: Provide extruded aluminum threshold plate. Mount with concealed mechanical fasteners. Allow for installation of finish flooring.

10. Finish Flooring: as selected by Owner's Representative.

D. Emergency Lighting; All Elevators: Provide an emergency car lighting unit mounted on top of car, battery driven and self-rechargeable. Upon outage of normal power the unit shall, within 5 seconds, light two lamps as part of normal car lighting or separate lights mounted above drop ceiling. The unit shall have sufficient capacity to keep the lights in continuous operation for four hours and also the alarm bell for one hour. Provide a readily accessible means for testing the unit in service cabinet. Light fixtures mounted in car front returns or operating panels are not acceptable.

2.10 HOISTWAY ENTRANCES; PASSENGER TYPE:

A. General: Fabricate finish work smooth with flush surfaces and free from warps and buckles. Entrance assemblies shall bear 1-1/2 hour U.L. rating. Provide entrances of size and type as scheduled.

B. Struts and Closer Angles: As required for entrance installation and door closer mechanism. Use full-length struts. Hanger headers, minimum 3/16 inch material extending from strut to strut.

C. Dust and Hanger Covers: Provide as required of minimum 16-gauge sheet steel. Provide hanger cover plates extending full length of door track. Paint black.

D. Fascia, Toe and Head Guards: Minimum 16 gauge sheet steel; reinforce fascia. Paint black. Provide blind fascia in express zones or for reverse openings as required.

E. Sills: Extruded sills with non-slip surfaces and grooves suitable for guides. Extend strut to strut and mount without exposed screws. Provide all support angles and levelers for a complete installation. Sill material as scheduled.

F. Frames: Fabricate from 14-gauge material with side jambs in one continuous piece from sill to head section. Head and jamb welded and ground smooth to provide unit frames with neat appearance from corridor side.

G. Doors: Fabricate from 16-gauge material sufficiently reinforced with steel to insure rigidity and sound deadened. Provide two guides per panel, which will remain engaged in sill if guiding member is destroyed. Provide full-length neoprene astragals on leading edge and non-vision wings of material and finish to match doors. There shall be no keyholes in the door unless required by governing authority. Corridor side of door panel material and finish as scheduled. Return finish a minimum of 1/2 inch around edges of door.

H. Tactile Markings: Provide raised Braille and alpha characters, numerals or symbols similar to those for car stations of size required by governing authority. Locate on each entrance jamb at 60 inches above floor indicating floor designation. Material and finish of plates shall have contrasting background and mounting means similar to those on car panels.

1. Buildings with more than one elevator: Provide 3 in. elevator identification adjacent to or on each entrance frame at the designated level.

2.11 TRACTION ELEVATOR EQUIPMENT:

A. Design Criteria:

1. Performance:

a. Contract Speed: Maximum five percent (5%) speed variation under any loading condition in either direction.

b. Motion Time: Brake release to brake set as measured in both directions for a typical 12’-0” one floor run under any loading condition. After make-up of hoistway door interlock, initiate movement of car within 0.5 seconds.

1) 400 FPM: 5.4 seconds.

c. Door Open Times:

1) 3’-6” Center Open: 1.8 seconds
2) 3’-6” Side Open: 2.3 seconds.

d. Door Close Times: Minimum, without exceeding kinetic energy and closing force, allowed by code.

e. Door Dwell Times: Comply with A.D.A. formula and provide separate adjustable timers with initial settings as follows:

1) Main Lobby Hall Call: 5.0 seconds.
2) Upper Lobby Hall Call: 5.0 seconds.
3) Car Call: 5.0 seconds.
4) Interruption of Door Protective Device: Reduce dwell to 1.0 second after all ADA requirements have been met.

f. Leveling: Within 1/4 inch under any loading condition. Level into floor at all times, do not overrun floor and level back.
g. Re-leveling: Provide smooth and accurate releveling required due to cable stretch.
h. Operating Qualities: Owner's Representative will judge riding qualities of cars and enforce the following requirements. Make all necessary adjustments.
i. Acceleration and Deceleration: Starting and stopping shall be smooth and comfortable, without obvious steps of acceleration. Slowdown, stopping and leveling shall be without jars or bumps. Stopping upon operation of emergency stop switch shall be rapid but not violent.

1) Vertical Acceleration: Maximum 4 ft. per second squared. Maximum jerk 8 ft. per second cubed.
2) Horizontal Acceleration: Maximum 15 mg peak-to-peak measured at full speed for full travel in both directions.

j. Full Speed Riding: Free from vibration and sway.

2. Motor Control:

a. Equipment: Capable of operating at plus or minus ten percent of normal feeder voltage and plus or minus three percent of feeder frequency without damage or interruption of elevator service.
b. Control System: Digital closed loop feedback control incorporating positional and velocity selector system that is capable of operating continuously at contract speed and load for one hour without exceeding 50 degrees Centigrade from ambient machine room temperature. Design system to not adversely affect stability of voltage and frequency controls of emergency generator set or loads connected to emergency power bus during standby power operation. Provide direct shaft type encoders on hoist motors; friction drive type not permitted.
c. Car Load Sensing:

1) The control system shall sense the actual load condition of the elevator prior to any movement of the elevators. The start/acceleration pattern shall be adjusted to reflect the carload to achieve a smooth start/acceleration under all load conditions and location in the hoistway.
2) Provide load-sensing devices that utilize crosshead deflection or hoist rope pressure. System shall be accurate within 100 pounds and stable over extended periods.

3. Vibration and Sound Control: Manufacturer/Installer shall provide whatever means are needed to accomplish the following based on the designed structure for the project.

a. Vibration: Elevator equipment shall be sound isolated from beams and building structure to prevent objectionable noise and vibration transmission to occupied building spaces. The vibration measured from the operation of an elevator shall be less than human perceptibility within any occupied living space, working space or space that is being used by patrons of museums, libraries, theaters, etc. The vibration level shall be defined as indicated in ANSI S3.29 and shall be measured in only the vertical direction.
b. Airborne Noise: Maximum acoustical output level. The sound level in any living space, working space or space that is being used by patrons of museums, libraries, theaters, etc. shall be 30 dBA or less. The measurement shall be performed on fast and shall be the Lmax over the duration of the operation.

B. Guide Rails:

1. Size: Standard steel tees with backs machined for splice plates. Extend rails full depth of pits and mounted to continuous pit channels with adjustment bolts to allow for building settlement. Guide rails and brackets at the point of attachment to building structure shall have zero deflection and all code deflection requirements are at the point of building structure. Minimum weight in pounds per foot shall be 15 pounds for car and 15 pounds for counterweight.

2. Installation: Drawings indicate basic hoistway framing and special supports for rail brackets. Guide rails shall be sized or reinforced to span a distance of 14'-0". The Elevator Contractor shall provide all additional supports and/or rail backing required. Install plumb within 1/16 inch. File joints smooth.

C. Guide Shoes:

1. Roller Guides: Roller type with rubber composition tires, minimum 3/4 inch wide and fully adjustable spring loaded to provide continuous contact with rail surfaces. Balance car to insure equal guide shoe pressure on all wheels and not exceed manufacturer's recommendations.

a. Size: Nominal roller diameters shall be 6” for car and 3.5” for counterweight. As follows:

D. Hoist and Governor Suspension Means: Size and number to insure proper wearing qualities and compatible with driving and deflecting sheaves. Use only code approved suspension means. All suspension means shall be tensioned and pressure equalized between individual suspension means after final testing has been accepted by local governing authority.

E. Buffers: Mount on continuous pit channels with required blocking and supports. For deep walk-in pits, provide platforms with access ladders for servicing car buffers as acceptable to Elevator Code authorities. Provide reduced stroke buffers where necessary to maintain minimum pit depths as shown on drawings and where permitted by code. Oil buffers pistons shall be protected with bluing or canvas covers

F. Counterweights: Sectional metallic weights securely fastened in structural frame. Following for Seismic only Frame to be designed to maintain structural integrity without bending upon activation of a seismic force of .5 g. Weight shall occupy a minimum of two-thirds the height of the frame.

G. Safeties: Flexible guide clamp type mounted on underside of car frame.

H. Governor: Centrifugal speed type to be located at top of hoistway in machine room or in pit with protective covering over sheave, jaws and exposed gears. Pit tail sheave frame shall be ratchet or tension type held under 200 pounds tension. Governor can be self-re-setting type if code approved prior to installation. Provide controller with positive displacement jumper in the event of re-setting governor from elevator controller equipment room. Positive displacement jumper shall only be attached to controller in the event of governor re-setting by qualified personnel.

1. Elevator Car mounted governors are not permissible.

I. Car Frame and Platform:

1. Passenger Elevators: Steel frame with steel or double wood floor; isolate platform from car frame by rubber pads and provided with jacking bolts for pad replacement.

2. Service/Passenger Elevators: Freight type construction with heavy channels front and rear, metal stringers with steel or double layered wood floor. Design for Class C-3 freight loading to carry a one-piece load on a small electric hand truck with a maximum 1/4-inch deflection. Assume wheelbase of 24 inches wide by 48 inches long.

J. Traction Machines:

1. General: Provide machines with heavy structural steel bedplates and motors rated for 30 minute with maximum 50 degree Centigrade rise or better.

2. Machine Room-Less Traction: Provide manufacturer’s standard single wrap traction type AC motor as approved with 1:1 or 2:1 roping. Where motors are mounted directly over hoistway on machine bedplate assembly or attached to overhead hoistway steel framing make motor and alignment of deflector sheaves an integral part of assembly. Provide manufacturer’s standard type brake as an integral part of motor. Emergency brake can be an integral part of motor or attached to drive side of motor sheave, emergency brake shall be applied only after primary brake has been applied. No motion of motor for calibration of elevator in relationship to floor levels shall be permitted once elevator has performed stop at floor level.

K. Controller: As standard with approved manufacturer; overload relays in three legs of power circuit and in loop circuit; cabinets with NEMA-1 enclosures and doors arranged with locks or mechanical latches. Provide permanently marked symbols or letters identical to those on wiring diagrams adjacent to each component.

1. The controller wiring shall be carried out in a neat and workmanlike manner in accordance with relevant requirements of National Electric Code.

2. All external connections to the equipment on each controller shall be made by means of approved solderless cable lugs, depending on the current to be carried.

3. Main contactors shall be horsepower rated and are not to be mounted directly to the steel cabinets, to ensure quiet operation of controllers.

4. The controllers must be properly shielded from line feeder pollution.

L. Power Conversion and Regulation Unit:

1. All circuitry shall be as approved by the enforcing code. Operation shall be quiet and the performance standards herein specified shall be provided.
2. Design system to control starting and stopping and to prevent damage to motor from overload or excess current and to automatically disconnects power supply. Apply brake and bring car to rest in event of power failure or safety device operation.
3. Controllers shall not have failure modes which results in full power being applied to drive machine operation in event of phase reversal, phase failure or low voltage, which might result in elevator malfunction.
4. Provide system to convert 3 phase, 60 Hz, A.C. building power supply to a fixed D.C. voltage and then invert from D.C. voltage to a variable voltage, variable frequency, distortion-free, smooth A.C. current output to the A.C. hoist motor.
5. Varying the frequency input to the motor shall control motor speed; varying the voltage to the motor shall control torque.
6. System shall be provided with necessary devices to insure quiet operation not exceeding noise level specified in "Design Criteria" and to protect building system power line against line voltage transients.

M. Regenerative AC Drives:

1. Provide drives that have the capacity to recover wasted braking energy and return it to the building power grid. The system shall consist of three phase, full wave bridge rectifiers and be capable of producing clean energy with minimal distortion of the incoming sinusoidal waveform line current. Total Harmonic Distortion (THD) shall be at a nominal load equal to or below 5 percent to minimize pollution of the building's electrical power system.

N. Machine Beams and Sheaves: Provide all structural steel machine and sheave beams with dead end hitch plates, bearing plates, anchors and blocking as required to support equipment. Secondary, overhead and deflecting sheaves with roller bearings and means for lubricating bearings from machine rooms as required where secondary levels are not provided.

O. Machine room-less type applications provide permanently sealed motors, and deflector sheaves requiring no lubrication.

P. Compensation (as req.):

1. Chain Type: Encapsulated with pivoted compensating sheave having a nominal diameter of 25 inches to maintain loop, limit horizontal movement and prevent rubbing of chain on elevator equipment or hoistway items.

Q. Traction Elevator Battery Rescue System: Provide a battery driven unit which will initiate rescue operation in the event of a power failure. The system shall determine the weight in the elevator and determine location of the counterweight. The system shall move the elevator up or down one floor, open doors and shut down. Should a seismic switch be activated prior to or during this operation, the elevator car shall move away from the counterweight should the car and counterweight be in a location where the car must pass the counterweight. Service shall be restored automatically upon restoration of normal power supply.

PART 3 - EXECUTION

3.1 GENERAL:

A. Bidding Documents: Bidders shall examine architectural, structural, electrical and mechanical plans and specifications. Any discrepancies which affect the elevator work or conditions adverse to the bidder's equipment shall be brought to Owner's Representative's attention at least seven (7) days prior to the bid date. If no discrepancies are presented, changes required to accommodate bidders equipment become the responsibility and cost of the Elevator Contractor.

3.2 PREPARATION:

A. Field Measurements: Field-verify dimensions before proceeding with the work. Coordinate related work by other trades. Verify the following to be acceptable for installation of elevators.

B. Hoistway has been correctly sized and otherwise properly prepared.

1. Equipment supports are satisfactory.
2. Electrical rough-ins are correct.
3. Do not begin installation until unsatisfactory conditions have been corrected.

3.3 INSTALLATION:

A. General: Install per manufacturer's requirements, those of regulatory agencies and as specified.

B. Welded Construction: Provide welded connections for installation of elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustments, inspection, maintenance and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.

C. Sound Isolation: Mount rotating and vibrating elevator equipment and components on vibration-absorption mounts, designed to effectively prevent transmission of vibrations to structure and thereby, eliminate sources of structure-borne noise from elevator system.

D. Lubricate operating parts of systems, including ropes, as recommended by manufacturer.

E. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails, for accurate alignment of entrances with cars. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum, safe workable dimensions at each landing.

F. Erect guide rails plumb and parallel with maximum deviation of 1/16 inch. Anchorage of guide rails shall not compromise waterproofing. Do not bottom rails on pit floor.

G. Grout sills with non-staining, non-shrink grout. Set units accurately aligned with finished floor at landings.

H. Graphics: Provide graphics visible to public as selected by Owner’s Representative.

I. Manufacturer's Nameplates: Manufacturer's nameplates, trademarks or logos not permitted on surfaces visible to public.

J. Painting of machine room floor, walls and pit floors:

1. After the completion of the entire installation, the floor and walls of each machine room and pit areas shall be thoroughly cleaned down and brush painted with one coat of traffic paint having oil resistant properties. Pit floors shall be painted after the completion of the waterproofing. Owner’s Representative will advise the color.

2. Painting shall be performed either during normal working hours or after hours at no additional cost to the Owner.

3.4 TEMPORARY ELEVATOR USE DURING CONSTRUCTION:

A. General: Should the General Contractor require the use of any elevator during construction, Contractor shall make arrangements directly with the Elevator Contractor, coordinate temporary facilities and pay all costs associated with the protection, operation and use of elevators.

B. Maintenance: Elevators shall be maintained on a regular basis during the temporary construction use. A minimum of two hours per week per elevator shall be spent on examination, lubrication, adjusting and cleaning the elevator equipment.

C. Damage: The Owner is entitled to receive new elevator equipment upon final acceptance of the entire project. The Owner's representative will thoroughly examine all elevator equipment upon completion of temporary use and provide a punch-list outlining items that must be repaired or replaced to ensure the equipment is in new condition. Final acceptance and payment will not be made until all items have been satisfactorily completed.

D. Schedule: Sufficient time must be allowed to prepare and adjust temporary elevators so that the entire elevator installation is ready for final acceptance.

3.5 TEMPORARY ACCEPTANCE AND USE BY OWNER:

A. When an elevator is near completion and declared ready for service, before completion of other elevators, Owner agrees to accept elevator and place it into automatic service.

B. The elevator must be tested and inspected by regulatory agencies and a permit to operate issued.

C. A walk-through examination will be performed in the presence of Owner's Representative, General Contractor and Elevator Contractor to determine present condition of elevator.

D. The Owner agrees to sign or cause the General Contractor to sign a temporary acceptance form that is mutually agreeable to all parties.

E. During this temporary acceptance period, the Owner agrees to pay or cause the General Contractor to pay an agreed amount per day per elevator for regular maintenance. The cost for this maintenance per elevator, per day, shall be stated in the Elevator Contractor's bid.

F. The guarantee and full maintenance period will be effective upon final acceptance of the entire installation.

3.6 FIELD QUALITY CONTROL:

A. Regulatory Agencies Inspection: Upon completion of elevators, Contractor shall provide instruments, weights and personnel to conduct test required by regulatory agencies. The Contractor shall submit a complete report describing the results of the tests.

B. Examination and Testing: When installation is ready for final acceptance, notify and assist Owner's Representative in making a walk-through review of entire installation to assure workmanship and equipment complies with contract documents. Provide equipment to perform the following tests:

C. One-hour heat and run test with full load in car.

1. Perform for one car of each duty.

    a. Stop car at each floor in each direction.
    b. Provide well-shielded thermometers for motor and verify that temperatures do not exceed 50 degrees Centigrade above ambient. Infrared Temperature thermometers' are acceptable.
    c. Performance and leveling tests shall be made before and after heat and run test.
    d. Check and verify operation of all safety features and special operations.

2. Demonstrate and verify to the Owner's Representative the following:

    a. Measure horizontal acceleration for a full speed, full rise up and down run.
    b. Measure acoustical output levels in machine room, lobbies and cars for a full speed, full rise up and down run.

D. Correction: Make corrections to defects or discrepancies at no cost to Owner. Should discrepancies be such that re-examination and retesting is required, the Elevator Contractor shall pay for all costs including those of Owner's representative fees.

E. Final Acceptance: Final acceptance of the installation will be made only after all corrections are complete, final submittals and certificates received and the Owner is satisfied and the installation is complete in all respects. Final payment will not be made until the above is completed.

F. INSTRUCTIONS: Instruct Owner's personnel in proper use of each system during a minimum of one hour training session on the proper use of each system. This training session will be conducted onsite at the owner's convenience.

3.7 MAINTENANCE:

A. General: Provide complete continuing maintenance on entire elevator equipment during regular working hours on regular working days for a period of 12 months after filing Notice of Completion.

B. Examination: Include systematic examination, adjustment, and lubrication of elevator equipment whenever required and replacement of defective parts with parts of same manufacture as required for proper operation. Contractor not responsible for repairs to car enclosures, door panels, frames, sills or platform flooring resulting from normal usage or misuse, accidents and negligence for which Contractor is not responsible. Examinations shall be performed expending a minimum of the following per unit per visit performing preventative maintenance service.

1. Traction Elevators serving up to 5 Floors: 1.5 hours per unit twice per month.
2. Traction Elevators serving 6-20 Floors: 2.0 hours per unit twice per month.

C. Performance Standards:

1. Maintain the performance standard set forth in this Specification and maintain correct operation of the dispatching system.
2. Maintain smooth starting and stopping, smooth riding qualities and accurate leveling at all times.

D. Callbacks: In event of failures, provide 24-hour callback service at no additional cost to Owner.

E. Elevator Shutdowns: Should any elevator become inoperative, repair within 24 hours of notification of such failure. Breakdown of major components shall be completed and service restored within 72 hours.

1. Failure to comply with above, Owner may order the work done by other contractors at the Contractor's expense.
2. Devices repaired or replaced by others shall, nevertheless, be provided with maintenance by the Contractor who shall become completely responsible for correct operation of such devices for lifetime of this contract.

F. Follow-Up Tests: Test all safety devices and emergency operations at six (6) month intervals or oftener and submit written report on each test. Make tests at times which do not interfere with building operation.

G. Maintenance Materials:

1. Expendable Parts: The Elevator Contractor shall provide a metal cabinet in at least one machine room on project premises containing the following expendable parts required for prompt replacement. Parts used for routine maintenance shall be replenished and stored in machine room to ensure an adequate supply is available. Parts and cabinet shall become Owner's property and not removed upon expiration of maintenance period.

a. Two field replaceable resistors of each type installed.
b. One set hanger sheaves for car and hoistway doors.
c. Two relays and relay bases of each type installed.
d. Twenty-four lamps of each type installed.
e. Car and hall buttons with identical graphics installed; six for manufacturer's standard buttons, one of each type for special buttons.
f. Twelve fuses of each type installed.
g. Any other parts required for prompt replacement.
h. Lubricants and cleaners of all types used for maintenance.

2. Replacement Parts: Keep the following parts in a warehouse within 50 miles of the project premises.

a. One door operator motor of each type used.
b. Transformers of each type installed.
c. Two complete door interlocks.
d. Parts for motor drive units.
e. One complete motor drive of each size installed.
f. One encoder of each type installed.
g. Parts for door protective devices.
h. Such other parts as are needed to insure prompt replacement in event of elevator shutdown such as spare control boards for computer-operated systems.

H. Maintenance Data: After completion and prior to final acceptance, submit three sets of complete and accurate maintenance data specific for each elevator. Final payment will not be made until received.

I. Maintenance Manuals: Describe proper use and maintenance of equipment, lubrication points, types of lubricants used and frequency of lubricant application, manufacturer's literature describing system maintenance and troubleshooting as specified.

1. Owner’s Manuals: Describe operation of each feature, i.e. Independent Service, Security Operation, Guard Station Equipment, etc…that is specifically used by the owner or end user. Include details of what to do and what not to do with the elevator equipment In Case of Emergency, Seismic, Fire, Evacuation etc….,

2. Parts Catalogs: Complete listing of all parts of equipment and components used in the installation.

3. Wiring Diagrams: One set mounted in machine room, one blue line set and one electronic version on CD delivered to Owner. Wiring diagrams shall be as built, specific for this installation, and reference identification on drawings shall match points identified on terminals of controllers.

4. Maintenance Tool and Software Manuals: Provide maintenance tools and supporting software documentation required for the complete maintenance of the entire system including diagnostics ad adjusting. Maintenance tool may be hand held or built into control system and shall be of the type not requiring recharging or reprogramming nor of the automatic destruct type. The tool and supporting software may be programmed to operate only with this project's identification serial numbering. If control system is of the type that the software is field up loadable, both a copy of the control software and the parameters shall be clearly marked and submitted to the owner on CD.

J. Final Service and Inspection: Two weeks before expiration of the year's maintenance, the equipment shall be lubricated, fully serviced, adjusted to the standards designated and emergency service operation devices shall be checked. A representative of the Owner will make a complete inspection.

K. Quotation: Base bid shall include cost of maintenance and materials as described above.

END OF SECTION 142000

SECTION 211300 – FIRE SUPPRESSION SPRINKLER SYSTEM (DEFERRED APPROVAL)

PART 1 - GENERAL

1.1 SUMMARY

A. Work in this section includes, but is not necessarily limited to, providing all engineering, calculations, labor, materials, supervision, testing, permits and approvals required to design, install and obtain final acceptance of the automatic fire suppression system complete in all respects.

B. The fire sprinkler system is part of a "Deferred Approval." Coordinate with the requirements of Section 013300 "Submittal Procedures" and with the requirements for deferred approvals indicated on the title sheet of the drawings.

1.2 RELATED DIVISIONS

A. Section "General Requirements"

B. Section "Plumbing"

C. Section "Electrical"

D. Section "Fire Detection and Alarm"

1.3 CODES AND STANDARDS

A. California Building Standards Administrative Code, 2016 Edition

B. California Building Code (CBC), 2016 Edition.

C. California Fire Code (CFC), 2016 Edition.

D. California Electric Code (CEC), 2016 Edition.

E. California Mechanical Code (CMC), 2016 Edition

F. GeneTheory Fire Department Policies.

G. National Fire Protection Association (NFPA) 70 – *"National Electrical Code,"* 2014 Edition.

H. National Fire Protection Association (NFPA) 72 – *"National Fire Alarm and Signaling Code,"* 2016 Edition.

I. National Fire Protection Association (NFPA) 13 – "*Standard for the Installation of Sprinkler Systems*," 2016 Edition.

J. National Fire Protection Association (NFPA) 170 – "*Standard for Fire Safety and Emergency Symbols*," 2015 Edition

1.4 SYSTEM DESCRIPTION

A. The fire suppression system shall provide full and complete sprinkler coverage of all areas, and shall be compatible with the contract bid documents (specifications) and avoid interference with work of all other trades in the building.

B. Provide the fire suppression system in accordance with the applicable codes, standards and owner requirements; the more stringent requirement shall prevail. Contractor design shall provide sprinkler spacing, pipe sizes and pipe locations.

C. The fire sprinkler contractor shall coordinate piping locations with all other trades and around other trades as necessary. Additional system components that may be required for coordination shall be accounted for at time of bid; failure of the contractor to account for additional system components will be at the cost of the fire sprinkler contractor, the owner shall not be responsible for this or other costs associated with coordination.

1. The fire sprinkler contractor shall determine the locations of HVAC diffusers relative to proposed fire sprinkler branchlines. When possible HVAC diffusers shall be located to minimize fire sprinkler spray pattern development and associated relocation or addition of sprinkler heads. Prior to start of roof-level installs of any fire sprinklers or HVAC, agreement shall be reached on locations of sprinkler piping and HVAC diffusers. Any additional installation cost, to include moving branchlines, rerouting branchlines, moving HVAC diffusers or upgrades to any system will be the sole responsibility of the subcontractor not complying with the pre-install coordination with other trades.

D. Design and install new fire sprinkler system branch-line piping to run within the roof framing above the bottom chord of the bar joists/purlins and as tight to the roof deck as possible. Design and install new fire protection system main piping to run tight to the underside of beams, main piping shall run with slope of building, unless otherwise specified within the contract bid documents. Contractor to provide and install auxiliary drains at main piping where necessary.

E. The fire suppression system shall be complete with all UL (Underwriters Laboratories) listed components and/or FM (Factory Mutual) approved equipment and material items. Install and test in full conformity with the requirements of all applicable codes, National Fire Protection Association (NFPA) standards, any local code enforcing agencies, owner's insurance company, and owner's reviewing consultant.

F. Contractor shall carefully coordinate the locations of all sprinklers (dry pendent, upright or otherwise) with regards to obstructions; beams, joist, purlins, lights, conduit, and cooling units may obstruct the sprinkler discharge pattern from developing.

G. Sprinkler deflectors shall be positioned with consideration to obstructions and ceilings per NFPA 13.

H. Sprinklers in finished ceilings shall be symmetrically spaced to provide proper coverage, and to avoid interference with lights, diffusers, grilles, or other ceiling mounted equipment. Sprinklers located in ceiling tiles shall be “quarter pointed” +/-2-in. The sprinkler layout shall conform to a typical pattern.

I. Contractors’ suppression drawings and calculations must take into account and show the elevation loss from the flow test location to the flowing sprinklers. Backflow prevention and meter requirements shall be provided as specified in the fire suppression and civil contract bid documents. Acceptability of the backflow assembly must be approved by the Water Authority prior to installation. Actual pressure loss through backflow device(s) and/or water meter(s) must be indicated in the hydraulic calculations. Sprinkler contractor shall submit, with their calculations and shop drawings, a manufacturer's flow chart indicating pressure loss through the device(s) at the calculated flows.

1.5 SYSTEM DESIGN REQUIREMENTS

A. The fire suppression system design criteria shall be per the following and indicated on the sprinkler contractor’s suppression drawings for applicable areas of the building.
   1. Light Hazard
      0.10 gpm/sf over 1500 sf, 100 GPM hose stream allowance
   2. Ordinary Hazard Group 1
      0.15 gpm/sf over 1500 sf, 250 GPM hose stream allowance
   3. Ordinary Hazard Group 2
      0.20 gpm/sf over 1500 sf, 250 GPM hose stream allowance
   4. Extra Hazard Group 1
      0.30 gpm/sf over 2500 sf, 500 GPM hose stream allowance
   5. Extra Hazard Group 2
      0.40 gpm/sf over 2500 sf, 500 GPM hose stream allowance
   6. High-Piled Storage
      The design criteria will be determined per the requirements of NFPA 13 based on the storage configuration.
   7. Dry Pipe Storage
      The design criteria will be determined per the requirements of NFPA 13 based on the storage configuration and the use of a dry-pipe sprinkler system.

B. Provide automatic sprinklers along the non-atrium side of the glass atrium separation, as applicable. The sprinklers shall be located between 4 inches and 12 inches away from the glass and at intervals along the glass not greater than 6 feet. The design will account for the entire surface of the glass to be wet upon

activation of the sprinkler system without obstruction.

C. All calculations shall be balanced to within one half of one psi.

D. Above ground system velocities shall not exceed 32-ft/sec, and underground piping shall not exceed 20-ft/sec.

E. Include required hose allowance in the hydraulic calculations per NFPA 13 (i.e. 500 GPM hose provision with 100 GPM hose provision taken inside for systems with interior hose valves).

F. Limit each system to a maximum of 52,000 square feet and a maximum of 40,000 square feet for high storage areas as required by NFPA 13.

G. Inspectors test connections to be provided with a half inch smooth bore orifice, discharging at six inches above a hard paved surface or exterior grade. Inspectors test connections shall not be located behind racking or other obstructions, and shall be located within 12-in of the latch side of an exterior door opening. Inspectors test connections shall be piped to a location acceptable to the Owner. Inspectors test discharge shall not flow where pedestrian traffic is present or into any obstructions, such as doors, or into enclosed spaces such as vestibules. Inspectors test discharge may be routed to site planters where acceptable to the Owner. Where approved by the AHJ, a combination test-and-drain assembly may be used at each riser location.

H. Provide flushing and drainage as required per NFPA 13.

I. Contractor shall provide the appropriate signage at all control and drain valve locations. Locations shall include but not be limited to system control valves, drain valves, auxiliary drain valves, dry system drain valves, and hose connections. All signage shall be metallic and attached with sign chain.

J. Provide a calculation information card showing system demand and pressure required at the base of the riser, design density and area calculated, as well as installing contractor's address and phone number. Card shall be metal, and affixed to each riser with a chain.

K. System control valves shall be provided as required. All control valves shall be supervised and monitored through the fire alarm/ supervisory system and clearly marked as to their function and location.

L. Provide a weather proof electric bell mounted on the exterior wall as required. Device shall be mounted at approximately 8-ft to 10-ft above finished exterior grade and shall activate upon waterflow only.

M. Route all piping around all obstructions and provide sprinkler protection under mechanical units, ducting or other obstructions as required by NFPA 13.

N. Provide grooved, flanged or threaded connections for dry system piping and valves. Grooved fittings, including gaskets, shall be listed for dry pipe service.
   1. Grooving tools shall be of the same manufacturer as the grooved components.
   2. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

O. Systems shall be monitored by an offsite central station including tamper switches on all control valves, system flow detection devices (wet and dry), low air pressure switches (dry systems), etc. as applicable.

1.6 SUBMITTALS

A. Examine the contract bid documents and provide complete coordinated shop drawings as part of a “Deferred Approval.” Shop drawings shall be prepared in accordance with, and shall contain all information shown under "Working Plans", per NFPA 13. Provide “Water Supply Information” per NFPA 13 on the shop drawings. Hydraulic calculations shall be provided for all areas of work as indicated on the contract bid documents per the requirements of NFPA 13.

B. Grooved joint couplings and fittings shall be referred to on product submittals, and be identified by the manufacturer’s listed model or series designation.

C. Submit revised drawings and calculations for review and approval as required to accommodate changes to fixture plan, owner revisions, plan review comments or other contract documents during construction.

D. Deliver all certificates of inspections to the architect of record prior to final acceptance by owner.

E. Installation shall not commence until the fire department and owner have given written approval during the plan review process.

F. Submittals shall be complete, accurate, legible and in full compliance with the contract bid documents, code and owner requirements for proper and timely approval.

G. Plans shall be to scale. Sprinklers shall be referred to on drawings and product submittals, and be specifically identified by the manufacturer's listed model or series designation. Trade names and other abbreviated listings are not allowed.

1.7 FLOW TESTS

A. Flow test data provided as part of the contract documents shall be used as the available water supply.

B. Alternate flow test (those not as indicated on contract bid documents) will not be allowed unless approved in writing by the owner's fire protection consultant prior to bid. When required by AHJ, sprinkler contractor shall conduct a flow test or obtain a water model in accordance with the AHJ.

C. All flow test data shall be subject to the "10% rule" as defined in this paragraph. Reduce the recorded static and residual pressures by 10% of the static pressure. Make no reduction to the flow rate reported. When static pressure is 50-psi or less, provide a minimum 5-psi buffer from the static and residual pressures. When static pressure is 100-psi or greater, provide a maximum of 10-psi buffer from the static and residual pressures, unless unacceptable to the Authority Having Jurisdiction. Contractor shall provide additional buffers as may be required by the local AHJ and reviewing authorities at no additional cost to owner.

1.8 WARRANTY

A. Provide warranty in accordance with the General Conditions.

B. The contractor shall further warrant that in the event of the failure of any system or its component equipment items, or the improper functioning thereof, during the period of the warranty, the contractor shall have available, and on call, competent service personnel for the restoration of all systems and equipment for complete operation. Should the nature of the failure be such as to present an emergency, in the opinion of the owner, such personnel shall be promptly available, regardless of the hour of the day or the day of the week. Should the failure be such as to fall under the warranty, the cost of the service shall be borne by the contractor, otherwise, the owner will pay at the prevailing rate for such services.

C. If service personnel are not promptly available "on call" as required by the warranty, the owner may employ such personnel as are available to him at the expense of the contractor.

D. The manufacturer or his authorized distributor shall confirm that within a reasonable distance of the job site there is an established agency which stocks a full complement of parts and offers service during normal working hours on all equipment to be furnished, and that the agency will supply parts without delay and at reasonable cost.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All materials shall be as required by applicable codes and standards. All materials and equipment used shall be UL listed and/or Factory Mutual approved for use in fire sprinkler system installations.

B. Fire sprinklers shall be provided as indicated on the contract bid documents. All sprinklers shall be UL listed and Factory Mutual Approved. Orifice sizes, temperature ratings, finishes, and other criteria shall be as

indicated on the contract bid documents and as required by NFPA 13.

C. Escutcheons and guards supplied shall be listed and approved for use with the sprinkler by the sprinkler manufacturer.

D. Sprinkler Requirements:
   1. Sprinklers shall be listed in UL's "Fire Protection Equipment Directory".
   2. Sprinklers shall have a minimum pressure rating of 175 psig minimum.
   3. Sprinklers shall be provided with K-factors and temperature ratings as applicable for their use and as required by NFPA 13.
   4. Install corrosion resistant type sprinklers at exterior areas in accordance with the AHJ.

E. Provide sprinkler cabinets with quantities of spare sprinklers complying with NFPA 13
   1. All caps, plugs, covers, etc. shall remain on spare sprinklers to prevent potential damage of spare sprinklers prior to use.

F. Spare wrenches for the overhead sprinklers, recessed sprinklers and a universal wrench for standard 1/2-in. and 3/4-in. sprinklers shall also be provided.

G. Cabinets shall be attached to wall (or attached to uni-strut that is attached to wall) within the fire riser area and attached in a manner that allows for unobstructed opening of cabinet. Cabinet holes shall be cleared of burrs or other debris to minimize any damage to spare sprinklers.

H. The contractor shall provide a laminated list of the sprinklers provided which will be placed on the spare sprinkler cabinet(s).

I. Hangers, seismic bracing and thrust bracing attachments to building structure shall be per the requirements of NFPA 13 and/or as indicated on the bid documents, the more stringent requirement shall prevail. All hanger materials shall be UL listed and/or Factory Mutual approved for use in the support or bracing of fire sprinkler systems. All hanger attachments shall be submitted and acceptable to the project structural engineer and in accordance with NFPA 13. Seismic bracing shall be sized and spaced in accordance with the requirements of NFPA 13, and supporting calculations shall be provided by the installing contractor at the time of submittal. Thrust bracing shall be provided and installed regardless of seismic region or NFPA requirements at the tops of all risers and at each change in direction of dry system main piping.

J. All piping shall be new and approved for 175 psi working pressure conforming to ASTM A135 and A795 guidelines and FM approved for fire sprinkler system installation. All piping shall be black steel, prepared for painting.
   1. ASTM A53 piping is listed for use in sizes 2" through 6" only for fire sprinkler piping applications and should only be used if ASTM A795 listed piping is unavailable. Documentation must be obtained from the manufacturer and included in the Material Data Submittal stating that the ASTM A53 piping is UL Listed and FM approved for fire sprinkler applications.

K. Rusted, dented, or otherwise damaged piping will not be acceptable. All piping shall be capped and fully protected from exposure to the environment at all times to prevent rust during transit and storage onsite.

L. Contractor shall provide welding in accordance with NFPA 13. Contractor shall provide all welding stamps, certificates, or other documentation as required to gain approval from all authorities. Arrange for all weld inspections as required by the local authorities.

M. Approved shop welded outlets for the sprinklers shall be utilized.

2.2 DRY SYSTEM AIR COMPRESSORS

A. Air compressor serving dry sprinkler systems shall be sized by the contractor to meet published standards, local requirements and contract bid documents. Compressors shall be listed for use in automatic sprinkler systems. Coordinate all electrical requirements with all other trades.

B. Air compressor shall be riser mounted, floor or tank mounted air compressor will not be permitted.

2.3 FIRE PUMP

A. The need for a fire pump is required to be determined through analysis of the available water supply data.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation of automatic sprinkler systems shall be by a licensed and certified automatic sprinkler and/or fire protection contractor. References of satisfactory installations shall be furnished upon request.

B. All work shall be performed in accordance with NFPA 13.

C. Grooved joints shall be installed in accordance with the manufacturer's latest published installation instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks. Gaskets shall be molded and produced by the coupling manufacturer, and shall be verified as suitable for the intended service. Contractor shall remove and replace any improperly installed products.

D. The sprinkler contractor shall completely flush underground system piping prior to connection of overhead piping to underground piping per NFPA 24 (or obtain written confirmation that the underground has been flushed after completion of installation of underground piping). The minimum rate of flow shall be not less than the water demand rate of the system, which is determined by the system design including hose streams, or not less than that necessary to provide a velocity of 10-ft/s, whichever is greater, and should be continued for a sufficient time to ensure thorough cleaning. Underground piping shall be hydrostatically tested and flushed at 200-psi, or at 50-psi higher than the working pressure (whichever is greater) for 2 hours prior to connection to overhead piping. Flushing and testing shall be witnessed by the fire department. It shall be the responsibility of the fire sprinkler contractor to ensure that satisfactory flushing of the underground piping has occurred prior to connection to overhead sprinkler piping.

E. All brackets for attaching pipe hangers to building structure shall be the size and type for the intended use as shown on the contract bid documents and acceptable to the structural engineer and in accordance with NFPA 13 and Factory Mutual approved.

F. Furnish and install under this section all hangers and steel fabrications, other than building structure, required for proper support of piping and equipment.

G. All piping, piping supports, hangers and attachments shall be sized as required by NFPA 13 and shall be capable of resisting seismic forces as required by NFPA 13 or local building code. The more stringent requirement shall prevail.

H. Applicable only if sprinkler piping passes through concrete floors or walls: Contractor shall ensure that the required minimum clearance around piping passing through concrete is provided per the requirements of NFPA 13. All fire service underground piping shall be provided with a minimum 2-in clear space around the piping passing through concrete flooring.

I. Hanger attachment:
   1. Unless directed otherwise (contractor shall verify and coordinate) per structural engineer of record, the following shall apply;
      a. No cutting or punching is permitted in any structural member without prior written approval from the architect of record.
      b. Provide all necessary piping supports, hangers, attachments and seismic bracing complying with NFPA 13, structural engineer and manufacturer, local building code requirements and owner requirements, the more stringent requirement shall prevail. Provide thrust bracing as indicated elsewhere in this specification.

J. Any deviations and changes from the above criteria must be brought to the attention of the structural engineer in writing.

K. Filling the sprinkler system with air or water shall be done in such a manner as to minimize any horizontal thrust or undue lateral force. Prior to energizing sprinkler piping with water, a complete air pressure test shall be performed per the requirements of the NFPA 13.

L. All dry piping shall pitch to a low point drain. Drain piping shall not be located behind obstructions.

M. Carefully coordinate the locations of the pendent sprinkler (dry or otherwise) deflectors with regards to obstructions (i.e. fans, lighting, etc.). Obstructions that disrupt the sprinkler discharge pattern from developing must be spaced around accordingly and may require sprinklers behind obstructions to provide adequate sprinkler protection.

N. The contractor must ensure that the pendent sprinklers (concealed, dry or otherwise) comply with the obstruction criteria as indicated. Relocation or addition of the sprinklers, etc. will be at the cost of the fire sprinkler contractor, the Owner shall not be responsible for this or other associated costs.

O. All sprinkler system flushing to be routed to sanitary sewer, not storm drains, unless otherwise noted or required by Public Works or Health Department.

3.2 PAINTING

A. All horizontal piping shall be installed prior to painting.

B. Painting of the sprinkler piping and equipment if required shall be by the painting contractor; however, preparation of the sprinkler piping for the painting contractor is by the sprinkler contractor.

C. The sprinkler contractor is to remove all labels, stickers, fabrication identification tags, excess pipe dope, Teflon tape, oil residues and grease from the sprinkler piping before the system is turned over to the painting contractor for painting.

D. Any sprinkler over sprayed with paint shall be replaced. Cleaning of sprinklers to remove paint is not acceptable. Painted sprinklers shall be replaced at no additional cost to the owner.

3.3 INSPECTION, TESTING AND CLEANING

A. Arrange for all inspections, examinations and tests in full conformity with the requirements of all applicable codes, National Fire Protection Association (NFPA) standards, Authority Having Jurisdiction (AHJ), the owner's' insurance company, and the owner's fire protection consultant as necessary to obtain complete and final acceptance of the fire sprinkler system. The minimum test certificates to be submitted to the architect of record prior to final acceptance shall be an overhead hydro, overhead final, underground flush, dry system trip tests for all dry system valve locations and final fire sprinkler system building final.

B. Leave entire sprinkler system clean in every respect at the conclusion of the work. Contractor is to ensure that entire project is clean and free of construction related debris prior to final testing of systems. This shall be meant to include removing all loose debris from the floor and support areas, fire sprinkler riser enclosure where applicable.

C. After the systems have been installed, tested, and accepted, the contractor is to provide three copies of the operating instructions and maintenance manuals of all equipment. Included with these manuals are; a copy of the approved shop drawings, copy of NFPA 25, a spare parts list and a list of phone numbers of emergency repair personnel to the architect of record.

D. Two sets of as-built sprinkler shop drawings shall be provided to the architect of record upon completion and prior to final acceptance.

END OF SECTION 211300

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.
4. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.5 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.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.

2.2 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
C. Install piping at indicated slopes.
D. Install piping free of sags and bends.
E. Install fittings for changes in direction and branch connections.
F. Select system components with pressure rating equal to or greater than system operating pressure.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
E. 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.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. PVC Nonpressure Piping: Join according to ASTM D 2855.

J. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.

END OF SECTION 220500

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Bronze ball valves.
2. Bronze swing check valves.
3. Bronze globe valves.

B. Related Sections:

1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
2. Division 220553 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

A. CWP: Cold working pressure.
B. EPDM: Ethylene propylene copolymer rubber.
C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
D. NRS: Nonrising stem.

1.4 SUBMITTALS

A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.
D. AB1953 Compliance: Low Lead requirement for potable-water systems.

1.6 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 globe 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

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.
B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
C. Valve Sizes: Same as upstream piping unless otherwise indicated.
D. Valve Actuator Types:

1. Handlever: For quarter-turn valves NPS 6 (DN 150) and smaller except plug valves.
2. Wrench: For plug valves with square heads.

E. Valves in Insulated Piping: With 2-inch (50-mm) stem extensions and the following features:

1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

F. Valve-End Connections:

1. Solder Joint: With sockets according to ASME B16.18.
2. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Hammond Valve.
b. Milwaukee Valve Company.
c. NIBCO INC.
d. Red-White Valve Corporation.
e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig (4140 kPa).
c. Body Design: Two piece.
d. Body Material: Bronze.

e. Ends: Threaded.
f. Seats: PTFE or TFE.
g. Stem: Bronze.
h. Ball: Chrome-plated brass.
i. Port: Full.

B. Two-Piece, Regular-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Hammond Valve.
b. Milwaukee Valve Company.
c. NIBCO INC.
d. Red-White Valve Corporation.
e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig (4140 kPa).
c. Body Design: Two piece.
d. Body Material: Bronze.
e. Ends: Threaded.
f. Seats: PTFE or TFE.
g. Stem: Bronze.
h. Ball: Chrome-plated brass.
i. Port: Regular.

2.3 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Hammond Valve.
b. Milwaukee Valve Company.
c. NIBCO INC.
d. Red-White Valve Corporation.
e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

2.4 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Hammond Valve.
b. Milwaukee Valve Company.
c. NIBCO INC.
d. Red-White Valve Corporation.
e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded or solder joint.
e. Stem and Disc: Bronze.
f. Packing: Asbestos free.

PART 3 - EXECUTION

3.1 EXAMINATION

A. 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.
B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
C. Examine threads on valve and mating pipe for form and cleanliness.
D. 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.
E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
B. Locate valves for easy access and provide separate support where necessary.
C. Install valves in horizontal piping with stem at or above center of pipe.
D. Install valves in position to allow full stem movement.
E. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.

3.3 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.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball valves.
2. Throttling Service: Globe or ball valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.

3.5 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 PSIG (1035 kPa) OR LESS)

A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze Valves: May be provided with brazed solder-joint ends instead of threaded ends.
2. Ball Valves: Two piece, full port, bronze with bronze trim.
3. Bronze Swing Check Valves: Class 125, bronze disc.

3.6 LABROATORY VACUUM VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze Valves: May be provided with brazed solder-joint ends instead of threaded ends.
2. Ball Valves: Two piece, full port, bronze with bronze trim.
3. Bronze Swing Check Valves: Class 125, bronze disc.

3.7 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two piece, full port, bronze with bronze trim.
3. Bronze Swing Check Valves: Class 125, bronze disc.
4. Bronze Globe Valves: Class 125, bronze disc.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following hangers and supports for plumbing system piping and equipment:

1. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Pipe positioning systems.

1.3 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."

1.4 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.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Steel pipe hangers and supports.
2. Thermal-hanger shield inserts.
3. Powder-actuated fastener systems.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 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. Available Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.
2. ERICO/Michigan Hanger Co.
3. Globe Pipe Hanger Products, Inc.
4. Grinnell Corp.
5. Tolco Inc.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig- (690-kPa-) minimum, compressive-strength insulation insert encased in sheet metal shield.
B. Manufacturers:

1. Carpenter & Paterson, Inc.
2. ERICO/Michigan Hanger Co.
3. PHS Industries, Inc.
4. Pipe Shields, Inc.
5. Rilco Manufacturing Company, Inc.
6. Value Engineered Products, 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 (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.5 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.

1. Available Manufacturers:

a. Hilti, Inc.
b. ITW Ramset/Red Head.
c. Masterset Fastening Systems, Inc.

d. MKT Fastening, LLC.
e. Powers Fasteners.

B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated 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. Available Manufacturers:

a. B-Line Systems, Inc.; a division of Cooper Industries.
b. Empire Industries, Inc.
c. Hilti, Inc.
d. ITW Ramset/Red Head.
e. MKT Fastening, LLC.
f. Powers Fasteners.

2.6 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. Available Manufacturers:

1. C & S Mfg. Corp.
2. HOLDRITE Corp.; Hubbard Enterprises.
3. Samco Stamping, Inc.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
E. Use padded hangers for piping that is subject to scratching.
F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30 (DN 15 to DN 750).
2. 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.
3. 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.
4. 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).
5. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8 (DN 15 to DN 200).
6. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8 (DN 15 to DN 200).
7. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2 (DN 15 to DN 50).
8. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30 (DN 15 to DN 750).
9. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.

G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20 (DN 20 to DN 500).

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.

I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. C-Clamps (MSS Type 23): For structural shapes.
6. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
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.

J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

K. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
L. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
M. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
N. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.2 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
B. 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. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
D. 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.

E. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
F. 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.
G. Install lateral bracing with pipe hangers and supports to prevent swaying.
H. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
I. 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.
J. 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.
3. 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.

4. Insert Material: Length at least as long as protective shield.
5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

END OF SECTION 220529

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Pipe labels.
3. Valve tags.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Samples: For color, letter style, and graphic representation required for each identification material and device.
C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
D. Valve numbering scheme.
E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
B. Coordinate installation of identifying devices with locations of access panels and doors.
C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
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: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately

larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

C. 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), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pre-tensioned Pipe Labels: Pre-coiled, semi-rigid 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 1-1/2 inches (38 mm) high.

2.3 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.

1. Tag Material: Brass, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 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.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 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 (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
7. Space medium pressure natural gas labels in intervals of 5 feet (1.5 m)
8. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

B. Pipe Label Color Schedule:

1. Low-Pressure, Compressed-Air Piping:

   a. Background Color: White.
   b. Letter Color: Blue.

2. Medium-Pressure, Natural Gas Piping:

   a. Background Color: Yellow.
   b. Letter Color: Black.

3. Domestic Water Piping:

   a. Background Color: White.
   b. Letter Color: Green.

4. Laboratory Waste and Vent Piping:

   a. Background Color: White.
   b. Letter Color: Green.

3.4 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. List tagged valves in a valve schedule.

END OF SECTION 220553

SECTION 220700 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Insulation Materials:

a. Mineral fiber.

2. Insulating cements.
3. Adhesives.
4. Sealants.
5. Factory-applied jackets.
6. Tapes.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

1.5 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.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment 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.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
D. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Fibrex Insulations Inc.; Coreplus 1200.
b. Johns Manville; Micro-Lok.
c. Knauf Insulation; 1000(Pipe Insulation.
d. Manson Insulation Inc.; Alley-K.
e. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F (454 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Insulco, Division of MFS, Inc.; Triple I.
b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.

2.3 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.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.

c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 SEALANTS

A. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Products, Division of ITW; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: White.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

2.6 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
b. Compac Corp.; 104 and 105.
c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches (75 mm).
3. Thickness: 11.5 mils (0.29 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.
C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
E. Install multiple layers of insulation with longitudinal and end seams staggered.
F. 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.
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.

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- (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.
4. Cover joints and seams with tape as recommended by insulation material manufacturer 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.

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 (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
O. 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.

3.4 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: Install insulation continuously through penetrations of fire-rated walls and partitions.
C. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies.

3.5 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, vessels, and equipment. 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.

3.6 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches (150 mm) o.c.

4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.7 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.

3.8 FINISHES

A. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
C. Do not field paint aluminum or stainless-steel jackets.

3.9 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.
B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.

2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.10 INDOOR PIPING INSULATION SCHEDULE

A. Domestic and Industrial Hot and Recirculated Hot Water:

1. NPS 1-1/4 (DN 32) and Smaller: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.

2. NPS 1-1/2 (DN 40) and Larger: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch (38 mm) thick.

END OF SECTION 220700

SECTION 221113 – FACILITY WATER DISTRIBUTION PIPING

PART 1 -GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes water-distribution piping and related components outside the building for water service, fire-service mains and combined water service and fire-service mains.

B. Utility-furnished products include water meters that will be furnished to the site, ready for installation.

1.3 DEFINITIONS

A. LLDPE: Linear, low-density polyethylene plastic.

B. PVC: Polyvinyl chloride plastic.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.

1. Wiring Diagrams: Power, signal, and control wiring for alarms.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.

B. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with requirements of utility company supplying water. Include tapping of water mains and backflow prevention.

2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.

3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.

E. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.

F. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.

G. NSF Compliance:

1. Comply with NSF 14 for plastic potable-water-service piping.

2. Comply with NSF 61 Annex G for materials for water-service piping and specialties for domestic water.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:

1. Ensure that valves are dry and internally protected against rust and corrosion.

2. Protect valves against damage to threaded ends and flange faces.

3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves, including fire hydrants, according to the following:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.

2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.9 PROJECT CONDITIONS

A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of service.

2. Do not proceed with interruption of water-distribution service without Construction Manager's written permission.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Soft Copper Tube: ASTM B 88, Type L, water tube, annealed temper.

1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.

2. Copper, Pressure-Seal Fittings:

a. NPS 2 and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.

b. NPS 2-1/2 to NPS 4: Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.

B. Hard Copper Tube: ASTM B 88, Type K water tube, drawn temper.

1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.

2. Copper, Pressure-Seal Fittings:

a. NPS 2 and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.

b. NPS 2-1/2 to NPS 4: Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.

C. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.

D. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body with ball-and-socket, metal-to¬metal seating surfaces, and solder-joint or threaded ends.

2.2 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.

1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile-or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

2. Glands, Gaskets, and Bolts: AWWA C111, ductile-or gray-iron glands, rubber gaskets, and steel bolts.

B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.

1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile-or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

2. Gaskets: AWWA C111, rubber.

C. Grooved-Joint, Ductile-Iron Pipe: AWWA C151, with cut, rounded-grooved ends.

1. Grooved-End, Ductile-Iron Pipe Appurtenances:

a. Grooved-End, Ductile-Iron Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.

b. Grooved-End, Ductile-Iron-Piping Couplings: AWWA C606, for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.

D. Flanges: ASME 16.1, Class 125, cast iron.

2.3 PVC PIPE AND FITTINGS

A. PVC, Schedule 40 Pipe: ASTM D 1785.

1. PVC, Schedule 40 Socket Fittings: ASTM D 2466.

B. PVC, Schedule 80 Pipe: ASTM D 1785.

1. PVC, Schedule 80 Socket Fittings: ASTM D 2467.

2. PVC, Schedule 80 Threaded Fittings: ASTM D 2464.

C. PVC, AWWA Pipe: AWWA C900, Class 235 (DR18) and Class 305 (DR14), with bell end with gasket, and with spigot end.

1. Comply with UL 1285 for fire-service mains if indicated.

2. PVC Fabricated Fittings: AWWA C900, Class 235 (DR18) and 305 (DR14), with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.

3. PVC Molded Fittings: AWWA C907, Class 235 (DR18) and 305 (DR14), with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.

4. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile-or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

a. Gaskets: AWWA C111, rubber.

5. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile-or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

a. Glands, Gaskets, and Bolts: AWWA C111, ductile-or gray-iron glands, rubber gaskets, and steel bolts.

2.4 SPECIAL PIPE FITTINGS

A. Ductile-Iron Rigid Expansion Joints:

1. Description: Three-piece, ductile-iron assembly consisting of telescoping sleeve with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

a. Pressure Rating: 250 psig minimum. B. Ductile-Iron Flexible Expansion Joints:

1. Description: Compound, ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include two gasketed ball-joint sections and one or more gasketed sleeve sections. Assemble components for offset and expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

    a. Pressure Rating: 250 psig minimum.

C. Ductile-Iron Deflection Fittings:

1. Description: Compound, ductile-iron coupling fitting with sleeve and 1 or 2 flexing sections for up to 15-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

    a. Pressure Rating: 250 psig minimum.

2.5 JOINING MATERIALS

A. Brazing Filler Metals: AWS A5.8, BCuP Series.

B. Bonding Adhesive for Fiberglass Piping: As recommended by fiberglass piping manufacturer.

C. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

2.6 PIPING SPECIALTIES

A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

B. Tubular-Sleeve Pipe Couplings:

1. Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners and with ends of same sizes as piping to be joined.

    a. Standard: AWWA C219.

    b. Gasket Material: Natural or synthetic rubber.

    c. Pressure Rating: 150 psig minimum.

    d. Metal Component Finish: Corrosion-resistant coating or material.

2.7 CORROSION-PROTECTION PIPING ENCASEMENT

A. Encasement for Underground Metal Piping:

1. Standards: ASTM A 674 or AWWA C105.

2. Form: Sheet.

3. Material: LLDPE film of 0.008-inch minimum thickness.

4. Material: LLDPE film of 0.008-inch minimum thickness, or high-density, crosslaminated PE film of 0.004-inch minimum thickness.

5. Material: High-density, crosslaminated PE film of 0.004-inch minimum thickness.

6. Color: Black.

2.8 GATE VALVES

A. AWWA, Cast-Iron Gate Valves:

1. Nonrising-Stem, Resilient-Seated Gate Valves:

a. Description: Gray-or ductile-iron body and bonnet; with bronze or gray-or ductile-iron gate, resilient seats, bronze stem, and stem nut.

b. b Standard: AWWA C509. 2) Minimum Pressure Rating: 200 psig. 3) End Connections: Mechanical joint. 4) Interior Coating: Complying with AWWA C550.

2. OS&Y, Rising-Stem, Resilient-Seated Gate Valves:

a. Description: Cast-or ductile-iron body and bonnet, with bronze or gray-or ductile-iron gate, resilient seats, and bronze stem.

b. b Standard: AWWA C509. 2) Minimum Pressure Rating: 200 psig. 3) End Connections: Flanged.

B. UL/FMG, Cast-Iron Gate Valves:

1. UL/FMG, Nonrising-Stem Gate Valves:

a. Description: Iron body and bonnet with flange for indicator post, bronze seating material, and inside screw.

b. b Standards: UL 262 and FMG approved. 2) Minimum Pressure Rating: 175 psig. 3) End Connections: Flanged.

2. OS&Y, Rising-Stem Gate Valves:

a. Description: Iron body and bonnet and bronze seating material.

b. b Standards: UL 262 and FMG approved. 2) Minimum Pressure Rating: 175 psig. 3) End Connections: Flanged.

2.9 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies:

1. Description: Sleeve and valve compatible with drilling machine.

a. Standard: MSS SP-60.

b. Tapping Sleeve: Cast-or ductile-iron or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.

c. Valve: AWWA, cast-iron, nonrising-stem, resilient-seated gate valve with one raised face flange mating tapping-sleeve flange.

B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches in diameter.

1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

C. Indicator Posts: UL 789, FMG-approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.

2.10 CHECK VALVES

A. AWWA Check Valves:

1. Description: Swing-check type with resilient seat. Include interior coating according to AWWA C550 and ends to match piping.

a. Standard: AWWA C508.

b. Pressure Rating: 175 psig.

B. UL/FMG, Check Valves:

1. Description: Swing-check type with pressure rating; rubber-face checks, unless otherwise indicated; and ends matching piping.

a. Standards: UL 312 and FMG approved.

b. Pressure Rating: 175 psig.

2.11 DETECTOR CHECK VALVES

A. Detector Check Valves:

1. Description: Galvanized cast-iron body, bolted cover with air-bleed device for access to internal parts, and flanged ends. Include one-piece bronze disc with bronze bushings, pivot, and replaceable seat. Include threaded bypass taps in inlet and outlet for bypass meter connection. Set valve to allow minimal water flow through bypass meter when major water flow is required.

a. Standards: UL 312 and FMG approved.

b. Pressure Rating: 175 psig.

c. Water Meter: AWWA C700, disc type, at least one-fourth size of detector check valve. Include meter, bypass piping, gate valves, check valve, and connections to detector check valve.

2. Description: Iron body, corrosion-resistant clapper ring and seat ring material, flanged ends, with connections for bypass and installation of water meter.

a. Standards: UL 312 and FMG approved.

b. Pressure Rating: 175 psig.

2.12 CORPORATION VALVES

A. Service-Saddle Assemblies: Comply with AWWA C800. Include saddle and valve compatible with tapping machine.

1. Service Saddle: Copper alloy with seal and AWWA C800, threaded outlet for corporation valve.

2. Corporation Valve: Bronze body and ground-key plug, with AWWA C800, threaded inlet and outlet matching service piping material.

3. Manifold: Copper fitting with two to four inlets as required, with ends matching corporation valves and outlet matching service piping material.

2.13 WATER METERS

A. Displacement-Type Water Meters:

1. Description: With bronze main case.

a. Standard: AWWA C700.

b. Registration: Flow in gallons.

B. Compound-Type Water Meters:

1. Description:

a. Standard: AWWA C702.

b. Registration: Flow in gallons.

2.14 RELIEF VALVES

A. Air-Release Valves:

1. Description: Hydromechanical device to automatically release accumulated air.

a. Standard: AWWA C512.

b. Pressure Rating: 300 psig.

c. Body Material: Cast iron.

d. Trim Material: Stainless steel, brass, or bronze.

B. Air/Vacuum Valves:

1. Description: Direct-acting, float-operated, hydromechanical device with large orifice to automatically release accumulated air or to admit air during filling of piping.

a. Standard: AWWA C512.

b. Pressure Rating: 300 psig.

c. Body Material: Cast iron.

d. Trim Material: Stainless steel, brass, or bronze.

2.15 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

1. Standard: AWWA C511.

2. Operation: Continuous-pressure applications.

3. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.

4. Size: As noted.

5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.

6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

7. Configuration: Designed for horizontal, straight through flow.

8. Accessories:

9. Approved by USC Foundation for Cross-connection Control and Hydraulic Research.

B. Reduced-Pressure-Detector, Fire-Protection Backflow Preventer Assemblies:

1. Standards: UL listed or FMG approved.

2. Operation: Continuous-pressure applications.

3. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.

4. Size: As noted.

5. Body: Cast iron with interior lining complying with AWWA C550 or that is FDA approved.

6. End Connections: Flanged.

7. Configuration: Designed for horizontal, straight through or vertical inlet, horizontal center section, and vertical outlet flow.

8. Accessories:

a. Valves: UL 262, FMG-approved, OS&Y gate type with flanged ends on inlet and outlet.

b. Air-Gap Fitting: ASME A112.1.2, matching backflow preventer connection.

c. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

9. Approved by USC Foundation for Cross-connection Control and Hydraulic Research.

C. Backflow Preventer Test Kits:

1. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.16 WATER METER BOXES

A. Description: Polymer-concrete body and cover for disc-type water meter, with lettering "WATER" in cover; and with slotted, open-bottom base section of length to fit over service piping. Include vertical and lateral design loadings of 15,000 lb minimum over 10 by 10 inches square.

2.17 FIRE HYDRANTS

A. Wet-Barrel Fire Hydrants:

1. Description: Freestanding, with one NPS 4-1/2 and two NPS 2-1/2 outlets, NPS 6 threaded or flanged inlet, and base section with NPS 6 mechanical-joint inlet. Include interior coating according to AWWA C550.

    a. Standard: AWWA C503.

    b. Pressure Rating: 150 psig minimum.

2. Description: Freestanding, with one NPS 4-1/2 and two NPS 2-1/2 outlets, NPS 6 threaded or flanged inlet, and base section with NPS 6 mechanical-joint inlet.

    a. Standards: UL 246 and FMG approved.

    b. Pressure Rating: 150 psig minimum.

    c. Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with steel chains.

    d. Operating and Cap Nuts: Pentagon, 1-1/2 inches point to flat.

    e. Direction of Opening: Open hydrant valves by turning operating nut to left or counterclockwise.

    f. Exterior Finish: Yellow alkyd-gloss enamel paint, unless otherwise indicated.

2.18 FIRE DEPARTMENT CONNECTIONS

A. Fire Department Connections:

1. Description: Freestanding, with cast-bronze body, thread inlets according to NFPA 1963 and matching local fire department hose threads, and threaded bottom outlet. Include lugged caps, gaskets, and chains; lugged swivel connection and drop clapper for each hose-connection inlet; 18¬inch-high brass sleeve; and round escutcheon plate.

    a. Standard: UL 405.

    b. Connections: Two NPS 2-1/2 inlets and one NPS 6 outlet.

    c. Inlet Alignment: Inline, horizontal.

    d. Finish Including Sleeve: Polished bronze.

    e. Escutcheon Plate Marking: "AUTO SPKR & STANDPIPE."

PART 3 - EXECUTION

3.1 EARTHWORK

A. Refer to Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.

B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.

C. Do not use flanges or unions for underground piping.

D. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.

E. Underground water-service piping NPS 3/4 to NPS 3 shall be any of the following:

1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.

2. PVC, Schedule 40 pipe socket fittings; and solvent-cemented joints.

F. Underground water-service piping NPS 4 to NPS 8 shall be any of the following:

1. PVC, Schedule 40 pipe socket fittings; and solvent-cemented joints.

2. NPS 4 and NPS 6: NPS 6 PVC, AWWA Class 150 pipe; PVC, AWWA Class 150 fabricated or molded fittings; and gasketed joints.

3. NPS 8: PVC, AWWA Class 200 pipe; mechanical-joint, ductile-iron fittings; and gasketed joints.

G. Water Meter Box Water-Service Piping NPS 3/4 to NPS 2 shall be same as underground water-service piping.

H. Aboveground Water-Service Piping shall be the following:

1. Hard copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.

I. Aboveground water-service piping NPS 4 to NPS 8 shall be any of the following:

1. Hard copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.

2. Ductile-iron, grooved-end pipe; ductile-iron, grooved-end appurtenances; and grooved joints.

J. Underground Fire-Service-Main Piping shall be any of the following:

1. Ductile-iron, mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical joints.

2. PVC, AWWA Class 200 pipe listed for fire-protection service; PVC Class 200 fabricated fittings; and gasketed joints.

K. Aboveground Fire-Service-Main Piping shall be ductile-iron, grooved-end pipe; ductile-iron-pipe appurtenances; and grooved joints.

L. Underground Combined Water-Service and Fire-Service-Main Piping shall be any of the following:

1. Ductile-iron, mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical joints.

2. PVC, AWWA Class 200 pipe listed for fire-protection service; PVC fabricated or molded fittings of same class as pipe; and gasketed joints.

M. Aboveground Combined Water Service and Fire-Service-Main Piping shall be ductile-iron, grooved-end pipe; ductile-iron-pipe appurtenances; and grooved joints.

3.3 VALVE APPLICATIONS

A. General Application: Use mechanical-joint-end valves for NPS 3 and larger underground installation. Use threaded-or flanged-end valves for installation in vaults. Use UL/FMG, nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for NPS 2 and smaller installation.

B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Underground Valves, NPS 3 and Larger: AWWA, cast-iron, nonrising-stem, resilient-seated gate valves with valve box.

2. Underground Valves, NPS 4 and Larger, for Indicator Posts: UL/FMG, cast-iron, nonrising-stem gate valves with indicator post.

3. Use the following for valves in vaults and aboveground:

a. Gate Valves, NPS 2 and Smaller: Bronze, nonrising stem.

b. Gate Valves, NPS 3 and Larger: AWWA, cast iron, OS&Y rising stem, resilient seated, UL/FMG, cast iron, OS&Y rising stem.

c. Check Valves: UL/FMG, swing type.

3.4 PIPING SYSTEMS -COMMON REQUIREMENTS

A. See Section 330500 "Common Work Results for Utilities" for piping-system common requirements.

3.5 PIPING INSTALLATION

A. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.

B. Make connections larger than NPS 2 with tapping machine according to the following:

1. Install tapping sleeve and tapping valve according to MSS SP-60.

2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.

3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.

4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.

C. Make connections NPS 2 and smaller with drilling machine according to the following:

1. Install service-saddle assemblies and corporation valves in size, quantity, and arrangement required by utility company standards.

2. Install service-saddle assemblies on water-service pipe to be tapped. Position outlets for corporation valves.

3. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.

4. Install corporation valves into service-saddle assemblies.

5. Install manifold for multiple taps in water main.

D. Comply with NFPA 24 for fire-service-main piping materials and installation.

1. Install PE corrosion-protection encasement according to ASTM A 674 or AWWA C105.

2. Install copper tube and fittings according to CDA's "Copper Tube Handbook."

E. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.

1. Install PE corrosion-protection encasement according to ASTM A 674 or AWWA C105.

F. Install PVC, AWWA pipe according to ASTM F 645 and AWWA M23.

G. Bury piping with depth of cover over top at least 36 inches, with top at least 12 inches below level of maximum frost penetration, and according to the following:

H. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.

1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.

I. Sleeves are specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

J. Mechanical sleeve seals are specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

K. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

L. See Section 211200 "Fire-Suppression Standpipes," Section 211313 "Wet-Pipe Sprinkler Systems," and Section 211316 "Dry-Pipe Sprinkler Systems" for fire-suppression-water piping inside the building.

M. See Section 221116 "Domestic Water Piping" for potable-water piping inside the building.

3.6 JOINT CONSTRUCTION

A. See Section 330500 "Common Work Results for Utilities" for basic piping joint construction.

B. Make pipe joints according to the following:

1. Copper-Tubing, Pressure-Sealed Joints: Use proprietary crimping tool and procedure recommended by copper, pressure-seal-fitting manufacturer.

2. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.

3. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.

4. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with grooved-end, ductile-iron-piping couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions.

5. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.

3.7 ANCHORAGE INSTALLATION

A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:

1. Concrete thrust blocks.

2. Locking mechanical joints.

3. Set-screw mechanical retainer glands.

4. Bolted flanged joints.

5. Pipe clamps and tie rods.

B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:

1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.

2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.

3. Fire-Service-Main Piping: According to NFPA 24.

C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.8 VALVE INSTALLATION

A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

B. UL/FMG, Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.

C. MSS Valves: Install as component of connected piping system.

D. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

E. Relief Valves: Comply with AWWA C512. Install aboveground with shutoff valve on inlet.

3.9 WATER METER INSTALLATION

A. Install water meters, piping, and specialties according to utility company's written instructions.

B. Water Meters: Install displacement-type water meters, NPS 2 and smaller, in meter boxes with shutoff valves on water meter inlets and outlets.

C. Water Meters: Install compound-type water meters, NPS 3 and larger, in meter vaults. Include shutoff valves on water meter inlets and outlets, support meters, valves, and piping on brick or concrete piers.

3.10 BACKFLOW PREVENTER INSTALLATION

A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.

B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.

C. Do not install bypass piping around backflow preventers.

D. Support NPS 2-1/2 and larger backflow preventers, valves, and piping near floor and on brick or concrete piers.

3.11 WATER METER BOX INSTALLATION

A. Install water meter boxes flush with surface.

3.12 CONCRETE VAULT INSTALLATION

A. Install precast concrete vaults according to ASTM C 891.

3.13 FIRE HYDRANT INSTALLATION

A. General: Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.

B. Wet-Barrel Fire Hydrants: Install with valve below frost line. Provide for drainage.

C. AWWA Fire Hydrants: Comply with AWWA M17.

D. UL/FMG Fire Hydrants: Comply with NFPA 24.

3.14 CONNECTIONS

A. See Section 330500 "Common Work Results for Utilities" for piping connections to valves and equipment.

B. Connect water-distribution piping to existing water main. Use tapping sleeve and tapping valve or service clamp and corporation valve.

C. Connect water-distribution piping to interior domestic water and fire-suppression piping.

3.15 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.

1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig. Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

C. Prepare reports of testing activities.

3.16 IDENTIFICATION

A. Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Section 312000 "Earth Moving."

3.17 CLEANING

A. Clean and disinfect water-distribution piping as follows:

1. Purge new water-distribution piping systems and parts of existing systems that have been altered, extended, or repaired before use.

2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.

3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:

    a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.

    b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.

    c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.

    d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

B. Prepare reports of purging and disinfecting activities.

END OF SECTION 221113

SECTION 221116 - DOMESTIC AND INDUSTRIAL WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.

1.3 SUBMITTALS

A. Product Data: For the following products:

1. Pipe, tube and fittings

1.4 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
B. Comply with NSF 14 for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type K (ASTM B 88M, Type B) water tube, drawn temper.

1. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

B. Soft Copper Tube: ASTM B 88, Type K (ASTM B 88M, Type A) water tube, annealed temper.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.
B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

2.4 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105.
B. Form: Sheet.
C. Material: High-density, cross-laminated PE film of 0.004-inch (0.10-mm) minimum thickness.
D. Color: Natural

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
C. Install underground copper tube in PE encasement according to ASTM A 674 or AWWA C105.
D. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 221119 Section "Domestic Water Piping Specialties" for pressure-reducing valves.
E. Install piping free of sags and bends.
F. Install fittings for changes in direction and branch connections.

3.2 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 pipes, tubes, and fittings before assembly.
C. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
D. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
E. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.3 VALVE INSTALLATION

A. Install shutoff valve close to water main. Use butterfly or gate valves for piping NPS 2-1/2 (DN 65) and larger.

3.4 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.
B. Transition Fittings in Underground Domestic Water Piping:

1. NPS 1-1/2 (DN 40) and Smaller: Fitting-type coupling.
2. NPS 2 (DN 50) and Larger: Sleeve-type coupling.

3.5 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
B. Dielectric Fittings for NPS 2 (DN 50) and smaller: Use dielectric unions.
C. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flange kits.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in this Section for pipe hanger and support products and installation.

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. 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.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping and tubing at base and at each floor.
C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch (10 mm).
D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 (DN 20) and smaller: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
2. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
4. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
5. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.

E. Install supports for vertical copper tubing every 10 feet (3 m).

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.
B. Piping Inspections:

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 one day 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 tests or inspections, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests:

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 new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
3. Leave new, altered, extended, or replaced 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 (345 kPa) 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 for corrective action required.

D. Domestic water piping will be considered defective if it does not pass tests and inspections.
E. Prepare test and inspection reports.

3.9 PIPING SCHEDULE

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 and unions may be used for aboveground piping joints unless otherwise indicated.
C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
D. Under-building-slab, domestic and industrial water, building service piping, NPS 4 (DN 100) and smaller shall be either of the following:

1. Hard copper ASTM B88 Type K (ASTM B88M, Type A) wrought-copper solder-joint fittings; and brazed joints. Encased in PE film

2. Soft copper Type K tubing annealed with no fittings conforming to ASTM B 88.

E. Under-building-slab, domestic water piping for trap primer application shall be the following:

1. Hard copper ASTM B88 Type K (ASTM B88M, Type A) wrought-copper solder-joint fittings; and brazed joints. Encased in PE film.

2. Soft copper Type K tubing annealed with no fittings conforming to ASTM B 88.

F. Aboveground domestic and industrial water piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100) shall be the following:

1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); wrought- copper solder-joint fittings; and soldered joints.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following domestic water piping specialties:

1. Water pressure-reducing valves.

2. Strainers.

B. Include the following:

1. Division 221116 Section "Domestic & Industrial Water Piping".

1.3 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig (860 kPa) unless otherwise indicated.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

1.5 QUALITY ASSURANCE

A. NSF Compliance:

1. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 WATER PRESSURE-REDUCING VALVES

A. Water Regulators

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Watts Industries, Inc.; Water Products Div.
b. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1003.

3. Pressure Rating: Initial working pressure of 150 psig (1035 kPa).
4. Size: See drawing.
5. Body: Bronze with chrome-plated finish for NPS 2 (DN 50) and smaller.
6. End Connections: Threaded for NPS 2 (DN 50) and smaller

2.2 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. Perforation Size:

a. StrainersNPS 2 (DN 50) and Smaller: [0.020 inch (0.51 mm)] [0.033 inch (0.84 mm)] [0.062 inch (1.57 mm)].

6. Drain: Factory-installed, hose-end drain valve.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 220500 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
B. Install water regulators with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.
C. Install Y-pattern strainers for water on supply side of each water pressure-reducing valve.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

3.3 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

END OF SECTION 221119

SECTION 221313 – FACILITY SANITARY SEWERS

PART 1 -GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipe and fittings.

2. Nonpressure and pressure couplings.

3. Expansion joints and deflection fittings.

4. Cleanouts.

5. Encasement for piping.

6. Manholes.

1.3 DEFINITIONS

A. PVC: Polyvinyl chloride plastic.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Expansion joints and deflection fittings.

B. Shop Drawings: For manholes. Include plans, elevations, sections, details, and frames and covers.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from sewer system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.

B. Field quality-control reports.

1.6 DELIVERY, STORAGE, AND HANDLING

2. Do not store plastic manholes, pipe, and fittings in direct sunlight.

3. Protect pipe, pipe fittings, and seals from dirt and damage.

4. Handle manholes according to manufacturer's written rigging instructions.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of service.

2. Do not proceed with interruption of service without Construction Manager's written permission.

PART 2 - PRODUCTS

2.1 PVC PIPE AND FITTINGS

A. PVC Type PSM Sewer Piping:

1. Pipe: ASTM D 3034, SDR 35 and SDR 26, PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.

2. Fittings: ASTM D 3034, PVC with bell ends.

3. Gaskets: ASTM F 477, elastomeric seals.

B. PVC Pressure Piping:

1. Pipe: Schedule 40 PVC pipe with bell-and-spigot ends.

2. Fittings: Schedule 40 PVC pipe with bell ends.

2.2 NONPRESSURE-TYPE TRANSITION COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:

1. For Cast-Iron Soil Pipes: ASTM C 564, rubber.

2. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.

3. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings:

1. Description: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

D. Shielded, Flexible Couplings:

1. Description: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

E. Ring-Type, Flexible Couplings:

1. Description: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

F. Nonpressure-Type, Rigid Couplings:

1. Description: ASTM C 1461, sleeve-type, reducing-or transition-type mechanical coupling, molded from ASTM C 1440, TPE material; with corrosion-resistant-metal tension band and tightening mechanism on each end.

2.3 CLEANOUTS

A. PVC Cleanouts:

1. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.4 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105.

B. Material: Linear low-density polyethylene film of 0.008-inch or high-density, cross-laminated polyethylene film of 0.004-inch minimum thickness.

C. Form: Sheet or tube.

D. Color: Black.

2.5 MANHOLES

A. Standard Precast Concrete Manholes:

1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.

2. Diameter: 48 inches minimum unless otherwise indicated.

3. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.

4. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section; with separate base slab or base section with integral floor.

5. Riser Sections: 4-inch minimum thickness, of length to provide depth indicated.

6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated; with top of cone of size that matches grade rings.

7. Joint Sealant: ASTM C 990, bitumen or butyl rubber.

8. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.

9. Steps: Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12-to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches.

10. Adjusting Rings: Interlocking HDPE rings, with level or sloped edge in thickness and diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.

11. Grade Rings: Reinforced-concrete rings, 6-to 9-inch total thickness, with diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Manhole Frames and Covers:

1. Description: Ferrous; 24-inch ID by 7-to 9-inch riser, with 4-inch-minimum-width flange and 26¬inch-diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "SANITARY SEWER."

2. Material: ASTM A 48/A 48M, Class 35 gray iron unless otherwise indicated.

2.6 CONCRETE

A. General: Cast-in-place concrete complying with ACI 318, ACI 350/350R, and the following:

1. Cement: ASTM C 150, Type II.

2. Fine Aggregate: ASTM C 33, sand.

3. Coarse Aggregate: ASTM C 33, crushed gravel.

4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.

2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.

1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.

a. Invert Slope: 1 percent through manhole.

2. Benches: Concrete, sloped to drain into channel.

a. Slope: 8 percent.

D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.

2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

PART 3 -EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process

F. of microtunneling.

G. Install gravity-flow, nonpressure, drainage piping according to the following:

H. Install piping pitched down in direction of flow, at minimum slope of 2 percent unless otherwise indicated.

I. Install piping with 36-inch minimum cover.

G. Install force-main, pressure piping according to the following:

1. Install piping with restrained joints at tee fittings and at horizontal and vertical changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in¬place-concrete supports or anchors.

2. Install piping with 36-inch minimum cover.

3. Install PVC pressure piping according to AWWA M23 or to ASTM D 2774 and ASTM F 1668.

H. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure, drainage piping according to the following:

1. Join PVC Type PSM sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric¬seal joints or ASTM D 3034 for elastomeric-gasket joints.

2. Join dissimilar pipe materials with nonpressure-type, flexible or rigid couplings.

B. Join force-main, pressure piping according to the following:

1. Join PVC pressure piping according to AWWA M23 for gasketed joints.

2. Join dissimilar pipe materials with pressure-type couplings.

C. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

1. Use nonpressure flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.

a. Unshielded flexible couplings for pipes of same or slightly different OD.

b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.

c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

2. Use pressure pipe couplings for force-main joints.

3.4 MANHOLE INSTALLATION

A. General: Install manholes complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections with sealants according to ASTM C 891.

C. Install FRP manholes according to manufacturer's written instructions.

D. Form continuous concrete channels and benches between inlets and outlet. E. Set tops of frames and covers flush with finished surface.

E. Install manhole-cover inserts in frame and immediately below cover.

3.5 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318.

3.6 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.

2. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.

3. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.

4. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads.

B. Set cleanout frames and covers with tops flush with surrounding surface.

3.7 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains specified in Section 221316 "Sanitary Waste and Vent Piping."

B. Connect force-main piping to building's sanitary force mains specified in Section 221316 "Sanitary Waste and Vent Piping." Terminate piping where indicated.

C. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye fitting plus 6-inch overlap with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes by cutting opening into existing unit large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

    a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.

    b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

4. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

D. Connect to grease, oil and sand interceptors specified in Section 221323 "Sanitary Waste Interceptors."

3.8 CLOSING ABANDONED SANITARY SEWER SYSTEMS

A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:

1. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

B. Backfill to grade according to Section 312000 "Earth Moving."

3.9 IDENTIFICATION

A. Comply with requirements in Section 31200 "Earth Moving" for underground utility identification devices. Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.

1. Use detectable warning tape over ferrous piping.

2. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

3.10 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate report for each system inspection.

2. Defects requiring correction include the following:

    a. Alignment: Less than full diameter of inside of pipe is visible between structures.

    b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.

c. Damage: Crushed, broken, cracked, or otherwise damaged piping.

d. Infiltration: Water leakage into piping.

e. Exfiltration: Water leakage from or around piping.

1. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.

2. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.

2. Test completed piping systems according to requirements of authorities having jurisdiction.

3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.

4. Submit separate report for each test.

5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:

a. Fill sewer piping with water. Test with pressure of at least 10-foot head of water, and maintain such pressure without leakage for at least 15 minutes.

b. Close openings in system and fill with water.

c. Purge air and refill with water.

d. Disconnect water supply.

e. Test and inspect joints for leaks.

6. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI¬B-6, and the following:

a. Option: Test plastic gravity sewer piping according to ASTM F 1417.

7. Force Main: Perform hydrostatic test after thrust blocks, supports, and anchors have hardened. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than 150 psig.

a. Ductile-Iron Piping: Test according to AWWA C600, "Hydraulic Testing" Section.

b. PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.

c. Manholes: Perform hydraulic test according to ASTM C 969.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.11 CLEANING

A. Clean dirt and superfluous material from interior of piping. Flush with potable water.

END OF SECTION 221313

SECTION 221316 - SANITARY WASTE AND VENT AND INDUSTRIAL WASTE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following for soil, waste, condensate drainage and vent piping inside the building:

1. Pipe, tube, and fittings.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.
B. EPDM: Ethylene-propylene-diene terpolymer rubber.
C. PE: Polyethylene plastic.
D. PP: Polypropylene plastic
E. PVC: Polyvinyl chloride plastic.
F. CPVC: Chlorinated polyvinyl chloride plastic

1.4 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 (30 kPa).

B. Seismic Performance: Soil, waste, and vent piping and support and installation shall be capable of withstanding the effects of seismic events determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures."

1.5 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.
B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.

1. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.

a. Available Manufacturers:

1) ANACO.
2) Tyler Pipe; Soil Pipe Div.

2. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.

a. Available Manufacturers:

1) ANACO.
2) Tyler Pipe; Soil Pipe Div.

C. PP Drainage Pipe and Fittings: ASTM F 1412, pipe extruded and drainage-pattern fittings molded, with Schedule 40 dimensions, from PP resin with fire-retardant additive complying with ASTM D 4101; with fusion-joint ends.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Aboveground, soil and waste piping shall be the following:

1. Hubless cast-iron soil pipe and fittings heavy-duty shielded stainless-steel couplings; and hubless-coupling joints.

B. Aboveground, vent piping shall be the following:

1. Hubless cast-iron soil pipe and fittings; standard, shielded stainless-steel couplings; and hubless-coupling joints.

C. Underground, soil, waste, and vent piping shall be the following:

1. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
2. Dissimilar Pipe-Material Couplings: Shielded non-pressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

D. Underground, High Temperature (140 Deg. F) industrial waste and vent piping from a minimum of 10'-0" away from drain receiving high temperature waste shall be the following:

1. Duriron bell and spigot pipe and fittings.
2. Dissimilar Pipe-Material Couplings: Shielded non-pressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

E. Aboveground, Industrial waste piping shall be the following:

a. PP drainage pipe and fittings with fusion-joint ends.

F. Underground, Industrial waste piping shall be the following:

a. PP drainage pipe and fittings with fusion-joint ends.

3.2 PIPING INSTALLATION

A. Basic piping installation requirements are specified in Division 220500 Section "Common Work Results for Plumbing."
B. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
C. 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."
D. 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.
E. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
F. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:

1. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.

G. Install PP soil and waste drainage and vent piping according to ASTM D 2665.
H. Install underground PP & PVC soil and waste drainage piping according to ASTM D 2321.
I. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
J. Industrial Waste system shall be hydrostatically (water) tested after installation. Testing with compressed air or gas is not recommended.

3.3 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 220500 Section "Common Work Results for Plumbing."
B. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
C. PVC Non-pressure Piping Joints: Join piping according to ASTM D 2665.

3.4 HANGER AND SUPPORT INSTALLATION

A. "Hangers and Supports for Plumbing Piping and Equipment." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Install individual, straight, horizontal piping runs according to the following:

    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.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping and tubing at base and at each floor.
C. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
D. 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 (DN 150): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.

E. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).
F. Install vinyl-coated hangers for PP & CPVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 2 (DN 50): 33 inches (840 mm) with 3/8-inch (10-mm) rod.
2. NPS 2-1/2 (DN 65): 42 inches (840 mm) with 1/2-inch (10-mm) rod.
3. NPS 3 (DN 80): 42 inches (840 mm) with 1/2-inch (13-mm) rod.
4. NPS 4 and NPS 5 (DN 100): 48 inches (1220 mm) with 5/8-inch (16-mm) rod.

G. Install supports for vertical PP & CPVC piping every 72 inches (1830 mm).

3.5 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 Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.

3.6 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 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. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent 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. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg (250 Pa). Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
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.

3.7 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.

3.8 PROTECTION

A. Exposed PP & PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following sanitary drainage piping specialties:

1. Floor Cleanouts
2. Wall Cleanouts
3. Floor drains
4. Floor Sinks
5. Air Gap Fitting

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.
B. FOG: Fats, oils, and greases.
C. FRP: Fiberglass-reinforced plastic.
D. HDPE: High-density polyethylene plastic.
E. PE: Polyethylene plastic.
F. PP: Polypropylene plastic.
G. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

1.5 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
B. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Metal Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Watts Drainage Products Inc.

b. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M for adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Adjustable housing
5. Body or Ferrule: Cast iron.
6. Clamping Device: Required.
7. Outlet Connection: Threaded.
8. Closure: Brass plug tapered.
9. Adjustable Housing Material: Cast iron with set-screws or other device.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Medium Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
14. Standard: ASME A112.3.1.
15. Size: Same as connected branch.
16. Housing: Cast Iron.
17. Closure: Cast Iron with seal.
18. Riser: Cast Iron drainage pipe fitting to cleanout.

B. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Watts Drainage Products Inc.
b. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, drilled-and-threaded cast-iron plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
8. Wall Access: Round nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains FD-1 : Refer to Plumbing Schedule for make and model numbers of fixtures

2.3 FLOOR SINKS

A. Cast-Iron Floor Sinks FS-1: Refer to Plumbing Schedule for make and model numbers of fixtures

2.4 ROOF RECEPTORS

A. Roof Receptors RR-1: Refer to Plumbing Schedule for make and model numbers of fixtures

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 220500 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
2. Locate at minimum intervals of 100 feet (15 m).
3. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
D. 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.

E. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
2. Size: Same as floor drain inlet.

3.2 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 221319

SECTION 221323 - SANITARY WASTE INTERCEPTORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Grease interceptors.
2. Oil interceptors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of interceptor indicated.

B. Shop Drawings: For each type and size of precast-concrete interceptor indicated.

PART 2 - PRODUCTS

2.1 GREASE INTERCEPTORS

A. Grease Interceptors: Manufacturer as scheduled

B. Capacities and Characteristics:

1. Length by Width by Depth: 8’- 2” x 5’ – 1”.
2. Number of Compartments: Two.
3. Retention Capacity: 1000 gal..
4. Inlet and Outlet Pipe Size: 4”.
5. Installation Position: Underground with manhole riser to grade.

2.2 HYDROMECHANICAL GREASE INTERCEPTOR

A. Hydromechanical Grease Interceptor: Manufacturer as scheduled

B. Capacities and Characteristics:

1. Length by Width by Depth: 24.1” x 16.5” x 24.4”.
2. Grease Capacity: 70 gal..
3. Inlet and Outlet Pipe Size: 3”.

2.3 OIL INTERCEPTORS

A. Oil Interceptors: Manufacturer as scheduled

B. Capacities and Characteristics:

1. Capacity: 1500 gal..
2. Overall Dimensions: 96” x 62”.
3. Inlet and Outlet Pipe Size: 3”.

2.4 PRECAST-CONCRETE MANHOLE RISERS

A. Precast-Concrete Manhole Risers: Manufacturer as scheduled

1. Structural Design Loads:

a. Light-Traffic Load: Comply with ASTM C 890, A-8 (ASSHTO HS10-44).
b. Medium-Traffic Load: Comply with ASTM C 890, A-12 (ASSHTO HS15-44).
c. Heavy-Traffic Load: Comply with ASTM C 890, A-16 (ASSHTO HS20-44).
d. Walkway Load: Comply with ASTM C 890, A-03.

2. Length: From top of underground concrete structure to grade.
3. Riser Sections: 3-inch (75-mm) minimum thickness and 24-inch diameter.

B. Manhole Frames and Covers: Ferrous; 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser with 4-inch- (100-mm-) minimum width flange and 26-inch- (660-mm-) diameter cover.

1. Include indented top design with lettering cast into cover, using wording equivalent to the following:

a. Grease Interceptors in Sanitary Sewerage System: "INTERCEPTOR or GREASE INTERCEPTOR."

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 INSTALLATION

A. Install precast-concrete interceptors according to ASTM C 891. Set level and plumb.

B. Install manhole risers from top of underground concrete interceptors to manholes and gratings at finished grade.

C. Set tops of manhole frames and covers flush with finished surface in pavements. Set tops 3 inches (75 mm) above finish surface elsewhere, unless otherwise indicated.

D. Set metal interceptors level and plumb.

E. Set tops of metal interceptor covers flush with finished surface in pavements. Set tops 3 inches (75 mm) above finish surface elsewhere, unless otherwise indicated.

3.3 CONNECTIONS

A. Piping installation requirements are specified in Section 221316 "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Make piping connections between interceptors and piping systems.

3.4 IDENTIFICATION

A. Arrange for installation of green warning tapes directly over piping and at outside edges of underground interceptors.

1. Use warning tapes or detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

END OF SECTION 221323

SECTION 221329 - SANITARY SEWERAGE PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Submersible sewage pumps.
2. Sewage-pump basins and basin covers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Wiring Diagrams: For power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.4 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. UL Compliance: Comply with UL 778 for motor-operated water pumps.

PART 2 - PRODUCTS

2.1 SUBMERSIBLE SEWAGE PUMPS

A. Submersible, Fixed-Position, Single-Seal Sewage Pumps:

1. Description: Factory-assembled and -tested sewage-pump unit.
2. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sewage pump as defined in HI 1.1-1.2 and HI 1.3.
3. Pump Casing: Cast iron, with open inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.
4. Impeller: Statically and dynamically balanced, ASTM A 48/A 48M, Class No. 30 A cast iron and stainless steel, nonclog, open, or semiopen design for solids handling, and keyed and secured to shaft.
5. Pump and Motor Shaft: Stainless steel, with factory-sealed, grease-lubricated ball bearings.
6. Seal: Mechanical.
7. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.

    a. Motor Housing Fluid: Oil.

8. Controls:

    a. Enclosure: NEMA 250 Type 4X wall-mounted.
    b. Switch Type: Mechanical-float in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
    c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
    d. High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with mechanical-float, switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.

9. Control-Interface Features:

    a. Remote Alarm Contacts: For remote alarm interface.
    b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:

        1) On-off status of pump.
        2) Alarm status.

10. Control-Interface Features:

    a. Remote Alarm Contacts: For remote alarm interface.
    b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:

        1) On-off status of pump.
        2) Alarm status.

11. Guide-Rail Supports:

    a. Standard: SWPA's "Submersible Sewage Pumping Systems (SWPA) Handbook."
    b. Guide Rails: Vertical pipes or structural members, made of galvanized steel or other corrosion-resistant metal, attached to baseplate and basin sidewall or cover.
    c. Baseplate: Corrosion-resistant metal plate, attached to basin floor, supporting guide rails and stationary elbow.
    d. Pump Yoke: Motor-mounted or casing-mounted yokes or other attachments for aligning pump during connection of flanges.
    e. Movable Elbow: Pump discharge-elbow fitting with flange, seal, and positioning device.
    f. Stationary Elbow: Fixed discharge-elbow fitting with flange that mates to movable-elbow flange and support attached to baseplate.
    g. Lifting Cable: Stainless steel; attached to pump and cover at manhole.

B. Capacities and Characteristics:

1. Unit Capacity: 110 gpm.
2. Number of Pumps: Two.
3. Each Pump:

    a. Capacity: 110 gpm.
    b. Solids Handling Capability: 3 inches (75 mm) minimum.
    c. Total Dynamic Head: 15 feet.
    d. Speed: 1750 rpm.
    e. Discharge Pipe Size: 3 NPS.
    f. Motor Horsepower: 1.
    g. Electrical Characteristics:

        1) Volts: 208.
        2) Phases: Three.
        3) Hertz: 60.

2.2 SEWAGE-PUMP BASINS AND BASIN COVERS

A. Basins: Factory-fabricated, watertight, cylindrical, basin sump with top flange and sidewall openings for pipe connections.

1. Material: Fiberglass.
2. Reinforcement: Mounting plates for pumps, fittings, guide-rail supports if used, and accessories.
3. Anchor Flange: Same material as or compatible with basin sump, cast in or attached to sump, in location and of size required to anchor basin in concrete slab.

B. Basin Covers: Fabricate metal cover with openings having gaskets, seals, and bushings; for access to pumps, pump shafts, control rods, discharge piping, vent connections, and power cables.

1. Reinforcement: Steel or cast iron, capable of supporting foot traffic for basins installed in foot-traffic areas.

C. Capacities and Characteristics:

1. Diameter: 36 inches.
2. Depth: 48 inches.
3. Inlet No. 1:

a. Drainage Pipe Size: 3 NPS.

4. Vent Size: 2 NPS.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation and filling are specified in Section 312000"Earth Moving."

3.2 INSTALLATION

A. Pump Installation Standard: Comply with HI 1.4 for installation of centrifugal pumps.

END OF SECTION 221329

SECTION 221513 - LABORATORY GASES, AIR AND VACUUM PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes piping and related specialties for nitrogen, CO2, laboratory compressed-air systems operating at 150 psig (1035 kPa) or less and general service vacuum piping systems operating at 28 in Hg (0.98 Bar).
B. Related Sections include the following:

1. Division 221519 Section "Laboratory Air Compressors and Vacuum Pumps" for general-service air compressors and accessories.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Compressed-air piping and support and installation shall withstand effects of seismic events determined according to SEI/ASCE 7, "Minimum Design Loads for Buildings and Other Structures."

1.4 SUBMITTALS

A. Product Data: For the following:

1. Pipes, fittings, and valves.
2. Dielectric fittings.
3. Flexible pipe connectors.
4. Safety valves.
5. Pressure regulators. Include rated capacities and operating characteristics.
6. Automatic drain valves.
7. Filters. Include rated capacities and operating characteristics.

B. Operation and Maintenance Data: For general-service compressed-air piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or to AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS (CO2, Compressed and Vacuum)

A. Copper Tube: ASTM B 819, Type K or L, seamless, drawn-temper, medical gas tube that has been factory cleaned, purged, and sealed for oxygen service.

1. Fittings: Factory cleaned, purged, and bagged for oxygen service according to ASTM B 819 or field cleaned, purged, and bagged as specified in "Preparation" Article in Part 3.

a. Copper Pressure Fittings: ASME B16.22, wrought copper with dimensions for brazed joints.
b. Copper Unions: ASME B16.22 or MSS SP-123.

2.2 JOINING MATERIALS

A. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated.

2.3 VALVES

A. Copper-Alloy Ball Valves: MSS SP-110, 3-piece-body, full-port ball valve rated for 300-psig (2070-kPa) minimum working pressure; with chrome-plated brass ball, PTFE or TFE seats, blowout-proof stem, threaded or solder-joint ends, and locking-type handle designed for quarter turn between opened and closed positions.

1. Manufacturers:

a. Hill-Rom.
b. Milwaukee Valve Company.
c. NIBCO INC.

2.4 DIELECTRIC FITTINGS

A. General Requirements for Dielectric Fittings: Combination fitting of copper alloy and ferrous materials with insulating material; suitable for system fluid, pressure, and temperature. Include threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

2.5 FLEXIBLE PIPE CONNECTORS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flex-Hose Co., Inc.
2. Flexicraft Industries.
3. Hyspan Precision Products, Inc.
4. Metraflex, Inc.

C. Bronze-Hose Flexible Pipe Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: 200 psig (1380 kPa) minimum.
2. End Connections, NPS 2 (DN 50) and Smaller: Threaded copper pipe or plain-end copper tube.

D. Stainless-Steel-Hose Flexible Pipe Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: 200 psig (1380 kPa) minimum.
2. End Connections, NPS 2 (DN 50) and Smaller: Threaded steel pipe nipple.

2.6 SPECIALTIES

A. Safety Valves: ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," construction; National Board certified, labeled, and factory sealed; constructed of bronze body with poppet-type safety valve for compressed-air service.

1. Pressure Settings: Higher than discharge pressure and same or lower than receiver pressure rating.

B. Air-Line Pressure Regulators: Diaphragm operated, aluminum alloy or plastic body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 200-psig (1380-kPa) minimum inlet pressure, unless otherwise indicated.

C. Automatic Drain Valves: Stainless-steel body and internal parts, rated for 200-psig (1380-kPa) minimum working pressure, capable of automatic discharge of collected condensate.

D. Coalescing Filters: Coalescing type with activated carbon capable of removing water and oil aerosols; with color-change dye to indicate when carbon is saturated and warning light to indicate when selected maximum pressure drop has been exceeded. Include mounting bracket.

E. Mechanical Filters: Two-stage, mechanical-separation-type, air-line filters. Equip with deflector plates, resin-impregnated-ribbon-type filters with edge filtration, and drain cock. Include mounting bracket.

1. Provide with automatic feed device for supplying oil to lubricator.

PART 3 - EXECUTION

3.1 PREPARATION

A. Cleaning of Piping

1. Wash laboratory air piping and components in hot, alkaline-cleaner-water solution of sodium carbonate or trisodium phosphate in proportion of 1 lb (0.453 kg) of chemical to 3 gal. (11.3 L) of water.
2. Scrub to ensure complete cleaning.
3. Rinse with clean, hot water to remove cleaning solution.

3.2 PIPING APPLICATIONS

A. Compressed-Air Piping:

1. NPS 2 (DN 50) and Smaller: Type L (Type A or B), copper tube; wrought-copper fittings; and brazed joints under continuous nitrogen purge.

B. Vacuum Piping:

1. NPS 4 (DN 100) and Smaller: Type L (Type A or B), copper tube; wrought-copper fittings; and soldered joints.

C. Carbon Dioxide:

1. NPS 2 (DN 50) and Smaller: Type L (Type A or B), copper tube; wrought-copper fittings; and brazed joints under continuous nitrogen purge.

D. Drain Piping: Use the following piping materials:

1. NPS 2 (DN 50) and Smaller: Type M (Type C) copper tube; wrought-copper fittings; soldered joints.

3.3 TEST GAS

A. Description: Oil-free dry nitrogen complying with CGA P-9, for purging and testing of piping.

3.4 VALVE APPLICATIONS

A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for metal general-duty valves. Use metal valves, unless otherwise indicated.

1. Metal General-Duty Valves: Use valve types specified in "Valve Applications" Article in Division 22 Section "General-Duty Valves for Plumbing Piping" according to the following:

a. Low-Pressure Compressed Air, Nitrogen and Carbon Dioxide: Valve types specified for low-pressure compressed air.

b. Laboratory Vacuum Piping: Valve types specified for low-pressure compressed air.

3.5 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
B. Install piping concealed from view and protected from physical contact by building occupants, 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 otherwise indicated.
D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and to coordinate with other services occupying that space.
E. Install piping adjacent to equipment and machines to allow service and maintenance.
F. Install nipples, flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating, unless otherwise indicated.
G. Install eccentric reducers where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.
H. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.
I. Install thermometer and pressure gage on discharge piping from each air compressor and on each receiver. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping."
J. Install piping to permit valve servicing.
K. Install piping free of sags and bends.
L. Install fittings for changes in direction and branch connections.

3.6 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. 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.

D. Brazed Joints for Copper Tubing: Join according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
E. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Join according to ASTM B 828 or CDA's "Copper Tube Handbook."
F. Dissimilar Metal Piping Material Joints: Use dielectric fittings.

3.7 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping."
B. Install shutoff valves and unions compressed-air piping to air compressors.
C. Install shutoff valves and unions vacuum piping to vacuum pumps.
D. Install shutoff valve at inlet to each automatic drain valve, filter, lubricator, and pressure regulator.
E. Install check valves to maintain correct direction of compressed-air flow to and from compressed-air piping specialties and equipment.

3.8 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

3.9 FLEXIBLE PIPE CONNECTOR INSTALLATION

A. Install flexible pipe connectors in discharge piping of each air compressor.
B. Install flexible pipe connectors at inlet of vacuum pump receiver.

3.10 SPECIALTY INSTALLATION

A. Install safety valves on receivers in quantity and size to relieve at least the capacity of connected air compressors.
B. Install air-main pressure regulators in compressed-air piping at or near air compressors.
C. Install automatic drain valves on aftercoolers, receivers, and dryers. Discharge condensate onto nearest floor sink.
D. Install coalescing filters in compressed-air piping at or near air compressors and upstream from mechanical filters.
E. Install mechanical filters in compressed-air piping at or near air compressors and downstream from coalescing filters.

3.11 CONNECTIONS

A. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment and machine.

3.12 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.
B. Vertical Piping: MSS Type 8 or 42, clamps.
C. Individual, Straight, Horizontal Piping Runs:

1. 100 Feet (30 m) or Less: MSS Type 1, adjustable, steel clevis hangers.
2. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.

D. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
E. Base of Vertical Piping: MSS Type 52, spring hangers.
F. Support horizontal piping within 12 inches (300 mm) of each fitting and coupling.
G. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
H. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1/4 (DN 8): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
2. NPS 3/8 and NPS 1/2 (DN 10 and DN 15): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
3. NPS 3/4 (DN 20): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
4. NPS 1 (DN 25): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
5. NPS 1-1/4 (DN 32): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
6. NPS 1-1/2 (DN 40): 10 feet (3 m) with 3/8-inch (10-mm) rod.
7. NPS 2 (DN 50): 11 feet (3.4 m) with 3/8-inch (10-mm) rod.

I. Install supports for vertical copper tubing every 10 feet (3 m).

3.13 LABELING AND IDENTIFICATION

A. Install identifying labels and devices for general-service compressed-air piping, valves, and specialties. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.14 FIELD QUALITY CONTROL

A. Perform field tests and inspections.
B. Tests and Inspections:

1. Piping Leak Tests for Metal Compressed-Air and Vacuum Piping: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen to pressure of 50 psig (345 kPa) above system operating pressure, but not less than 150 psig (1035 kPa). Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
2. Repair leaks and retest until no leaks exist.
3. Inspect filters and pressure regulators for proper operation.

C. Prepare test reports.

END OF SECTION 221513

SECTION 221519 - LABORATORY AIR AND VACUUM EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following laboratory air and vacuum equipment and related accessories for laboratory facilities:

1. Vacuum Pumps, including receivers and outlet filters.
2. Air compressor, including tank, valves pressure gauges, regulator and filters

B. Related Sections include the following:

1. Division 221513 Section "Laboratory Air and Vacuum Piping" for compressed-air and vacuum piping, valves, alarms, and related specialties.

1.3 DEFINITIONS

A. Actual Air: Air delivered from air compressors. Flow rate is delivered compressed air measured in acfm (actual L/s).
B. Expanded Air: Air delivered from vacuum pumps. Flow rate is delivered expanded air measured in ecfm (expanded L/s).
C. Standard Air: Free air at 68 deg F (20 deg C) and 1 atmosphere (29.92 in. Hg) before compression or expansion and measured in scfm (standard L/s).

1.4 PERFORMANCE REQUIREMENTS

A. Laboratory air and vacuum equipment shall comply with NFPA 99, Level 4 requirements for laboratories in healthcare facilities.

1.5 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for the following laboratory air and vacuum equipment:

1. Vacuum pumps, including receivers and outlet filters.
2. Air compressor, including tank, valves pressure gauges, regulator and filters

B. Product Certificates: Certificates of shop inspection and data report for receiver tanks as required by ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
C. Startup service reports.
D. Operation and Maintenance Data: For the following laboratory air and vacuum equipment and accessories to include in emergency, operation, and maintenance manuals:

1. Vacuum pumps.

2. Air compressor.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative of laboratory air and vacuum equipment manufacturer for both installation and maintenance of units required for this Project.
B. Product Options: Drawings indicate size, profiles, and dimensional requirements of laboratory air and vacuum equipment and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.
D. ASME Compliance: Fabricate and label receiver tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
E. Comply with NFPA 70, "National Electrical Code."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PACKAGED LABORATORY VACUUM PUMPS AND RECEIVERS

A. Laboratory Lubricated Vane Vacuum System, VAC-1: Refer to Plumbing Schedule for equipment capacities and characteristics

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings.

2.3 DUPLEX INDUSTRIAL SCROLL AIR COMPRESSOR AND TANK

A. Oiless Scroll Tankmounted skid system, AC-1: Refer to Plumbing Schedule for equipment capacities and characteristics

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean equipment, accessories, and components that have not been cleaned for oxygen service and sealed or that are furnished unsuitable for laboratory applications, according to CGA G-4.1, "Cleaning Equipment for Oxygen Service."

3.2 CONCRETE BASES

A. Install concrete bases for laboratory air and vacuum equipment except diaphragm air compressors and vacuum pumps. Concrete base is specified in Division 15 Section "Basic Mechanical Materials and Methods," and concrete materials and installation requirements are specified in Division 3.

3.3 EQUIPMENT INSTALLATION

A. Install laboratory air and vacuum equipment according to NFPA 99.

B. Install laboratory air and vacuum equipment on concrete bases. Set and connect units according to manufacturers' written instructions. Install units level, plumb, and anchored to substrate in locations indicated. Maintain manufacturers' recommended clearances. Orient equipment so controls and devices are accessible for servicing.

1. Anchor packaged equipment to concrete base according to manufacturers' written instructions and seismic criteria applicable to Project.

    a. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
    b. Install epoxy-coated anchor bolts for supported equipment; extend through concrete base and anchor into structural concrete floor.
    c. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
    d. Install anchor bolts to elevations required for proper attachment to supported equipment.
    e. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

C. Vibration Isolation: Install [spring] [restrained spring] isolators with a minimum deflection. Vibration isolation devices and installation requirements are specified in Division 15 Section "Mechanical Vibration and Seismic Controls."

D. Vibration Isolation: Mount equipment with motors larger than 5 hp on vibration isolation equipment base as specified in Division 15 Section "Mechanical Vibration and Seismic Controls."

E. Maintain manufacturer's recommended clearances for service and maintenance.

F. Install the following devices on laboratory air equipment:

1. Thermometer, Pressure Gage, and Safety Valve: Install on each compressed-air receiver.
2. Pressure Regulators: Install downstream from air compressors, dryers, purification units, and filter assemblies.
3. Automatic Drain Valves: Install on intercoolers, aftercoolers, receivers, and dryers. Discharge condensate over nearest floor drain.

G. Install the following devices on laboratory vacuum equipment:

1. Thermometer, Vacuum Gage, and Vacuum Relief Valve: Install on each vacuum receiver.
2. Automatic Drain Valves: Install on vacuum receiver tanks. Discharge condensate over nearest floor drain.

3.4 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Connect piping to air compressors, vacuum pumps, and receivers, except safety relief valve connections, with flexible pipe connectors of materials suitable for service. Flexible pipe connectors and their installation are specified in Division 15 Section "Laboratory Air and Vacuum Piping."

D. Connect laboratory air and vacuum equipment to laboratory air and vacuum alarm system. Refer to Division 15 Section "Laboratory Air and Vacuum Piping" for alarm system.

E. Ground equipment according to Division 16 Section "Grounding and Bonding."

F. Connect wiring according to Division 16 Section "Conductors and Cables."
G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 LABELING AND IDENTIFICATION

A. Install identifying labels and devices for laboratory air and vacuum equipment according to NFPA 99. Refer to Division 15 Section "Mechanical Identification" for labeling and identification materials.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to test, inspect, and adjust components and equipment installation and to perform startup service.
B. Perform the following final checks:

1. Verify that specified tests of piping systems are complete.
2. Verify that potable-water supply connections to equipment have correct backflow preventer.
3. Check for piping connection leaks.
4. Check for lubricating oil in lubricated-type equipment.
5. Check belt drives for proper tension.
6. Verify that air compressor inlet filters and piping are clear.
7. Verify that vacuum equipment filters and piping are clear.
8. Check for equipment vibration-control supports and flexible pipe connectors and verify that equipment is properly attached to substrate.
9. Check safety valves for correct settings. Ensure that settings are greater than air-compressor discharge pressure but not greater than rating of system components.
10. Check vacuum relief valves for correct settings.
11. Check for proper seismic restraints.
12. Test operation of equipment safety controls and devices.
13. Drain receiver tanks.

C. Verify that laboratory air and vacuum equipment is installed and connected according to the Contract Documents.
D. Verify that electrical wiring installation complies with manufacturer's submittal and written installation requirements in Division 16 Sections.
E. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
F. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
G. Complete installation and startup checks according to manufacturer's written instructions.
H. Prepare written report documenting testing procedures and results.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain laboratory air and vacuum equipment. Refer to Division 1 Section "Closeout Procedures Demonstration and Training."

END OF SECTION 15252

SECTION 223400 - FUEL-FIRED DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following fuel-fired water heaters:

1. Commercial, high-efficiency, gas water heaters.
2. Compression tanks.
3. Water heater accessories.

1.3 DEFINITIONS

A. LP Gas: Liquefied-petroleum fuel gas.

1.4 SUBMITTALS

A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.
B. LEED Submittal:

1. Product Data for Prerequisite EA 2: Documentation indicating that units comply with ASHRAE/IESNA 90.1-2004, Section 7 - "Service Water Heating."

C. Shop Drawings: Diagram power, signal, and control wiring.
D. Product Certificates: For each type of [commercial] [and] [instantaneous] water heater, signed by product manufacturer.
E. Manufacturer Seismic Qualification Certification: Submit certification that commercial water heaters, accessories, and components will withstand seismic forces defined in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
b. 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. 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.

F. Source quality-control test reports.
G. Field quality-control test reports.

H. Operation and Maintenance Data: For water heaters to include in emergency, operation, and maintenance manuals.
I. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain same type of water heaters through one source from a single manufacturer.
B. Product Options: Drawings indicate size, profiles, and dimensional requirements of water heaters and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
D. ASHRAE/IESNA 90.1-2004Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004.
E. ASME Compliance:

1. Where ASME-code construction is indicated, fabricate and label commercial 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 water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.

F. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9" for all components that will be in contact with potable water.

1.6 COORDINATION

A. Coordinate size and location of concrete bases with Architectural and Structural Drawings.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-fired 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.

d. Compression Tanks: One year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 COMMERCIAL, GAS WATER HEATERS

A. Commercial, High-Efficiency, Gas Water Heaters: WH-#: Refer to Plumbing Schedule for equipment capacities and characteristics

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings

2.3 COMPRESSION TANKS

A. Description: ET-# Steel, pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air pre-charge to minimum system-operating pressure at tank.

1. Available Manufacturers:

a. AMTROL Inc.
b. Smith, A. O.; Aqua-Air Div.
c. Taco, Inc.
d. Watts Regulator Co.

2.4 WATER HEATER ACCESSORIES

A. Gas Shutoff Valves: ANSI Z21.15/CGA 9.1, manually operated. Furnish for installation in piping.
B. Gas Pressure Regulators: ANSI Z21.18, appliance type. Include pressure rating, capacity, and pressure differential required between gas supply and water heater.
C. Gas Automatic Valves: ANSI Z21.21, appliance, electrically operated, on-off automatic valve.
D. Combination Temperature and Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select each relief valve with sensing element that extends into storage tank.

1. Gas Water Heaters: ANSI Z21.22/CSA 4.4.
2. Oil-Fired Water Heaters: ASME rated and stamped and complying with ASME PTC 25.3.

E. Pressure Relief Valves: Include pressure setting less than working-pressure rating of water heater.

1. Gas Water Heaters: ANSI Z21.22/CSA 4.4.
2. Oil-Fired Water Heaters: ASME rated and stamped and complying with ASME PTC 25.3.

F. Water Heater Stand and Drain Pan Units: High-density-polyethylene-plastic, 18-inch- (457-mm-) high, enclosed-base stand complying with IAPMO PS 103 and IAS No. 2. Include integral or separate drain pan with raised edge and NPS 1 (DN 25) drain outlet with ASME B1.20.1 pipe thread.
G. Water Heater Stands: Water heater manufacturer's factory-fabricated steel stand for floor mounting and capable of supporting water heater and water. Provide dimension that will support bottom of water heater a minimum of 18 inches (457 mm) above the floor.
H. Water Heater Mounting Brackets: Water heater manufacturer's factory-fabricated steel bracket for wall mounting and capable of supporting water heater and water.
I. Drain Pans: Corrosion-resistant metal with raised edge. Provide dimensions not less than base of water heater and include drain outlet not less than NPS 3/4 (DN 20).
J. Piping Manifold Kits: Water heater manufacturer's factory-fabricated inlet and outlet piping arrangement for multiple-unit installation. Include piping and valves for field assembly that is capable of isolating each water heater and of providing balanced flow through each water heater.
K. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1-2004 or ASHRAE 90.2-2004.

2.5 SOURCE QUALITY CONTROL

A. Test and inspect water heater storage tanks, specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
B. Hydrostatically test commercial water heater storage tanks before shipment to minimum of one and one-half times pressure rating.
C. Prepare test reports.

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

A. Install commercial water heaters on concrete bases.

1. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket, suspended platform, or direct on floor is indicated.
2. Concrete base construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Install 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.
C. Install seismic restraints for commercial water heaters. Anchor to substrate.
D. Install gas water heaters according to NFPA 54.
E. Install gas shutoff valves on gas supplies to gas water heaters without shutoff valves.
F. Install gas pressure regulators on gas supplies to gas water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
G. Install automatic gas valves on gas supplies to gas water heaters, if required for operation of safety control.
H. Install oil-fired water heaters according to NFPA 31.
I. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. 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.
J. Install combination temperature and pressure relief valves in water piping for 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.
K. 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 water heaters that do not have tank drains. Refer to Division 22 Section "Domestic Water Piping Specialties" for hose-end drain valves.
L. Install thermometer on outlet piping of water heaters. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.
M. Install pressure gage(s) on inlet and outlet piping of commercial, fuel-fired water heater piping. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.
N. Assemble and install inlet and outlet piping manifold kits for multiple water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each water heater. Include shutoff valve and thermometer in each water heater inlet and outlet, and throttling valve in each water heater outlet. Refer to Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty valves and to Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.
O. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.
P. Fill water heaters with water.
Q. Charge compression tanks with air.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.
C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect [test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
B. Perform the following field tests and inspections and prepare test reports:

1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, confirm proper operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial water heaters. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 223400

SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following conventional plumbing fixtures and related components:

1. Fixtures, Faucets, Hose Bibbs
2. Protective shielding guards.
3. Fixture supports.
4. Kitchen sinks.

B. Related Sections include the following:

1. Division 15430 Section "Plumbing Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.
B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.
D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.
E. Fitting: Device that controls the flow of water into or out of the 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.
F. FRP: Fiberglass-reinforced plastic.
G. PMMA: Polymethyl methacrylate (acrylic) plastic.
H. PVC: Polyvinyl chloride plastic.
I. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.4 SUBMITTALS

A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

1.5 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"; for plumbing fixtures for people with disabilities.
D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
E. Low Lead Requirements: Comply with Senate Bill AB 1953 for lead content in plumbing fixture materials that will be in contact with potable water.
F. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
G. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
H. Comply with the following applicable standards and other requirements specified for plumbing fixtures:

1. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.
2. Vitreous-China Fixtures: ASME A112.19.2M.

I. Comply with the following applicable standards and other requirements specified for faucets:

1. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
2. Faucets: ASME A112.18.1.
3. Hose-Connection Vacuum Breakers: ASSE 1011.
4. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
5. NSF Potable-Water Materials: NSF 61.
6. Pipe Threads: ASME B1.20.1.
7. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
8. Supply Fittings: ASME A112.18.1.
9. Brass Waste Fittings: ASME A112.18.2.

J. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:

1. Atmospheric Vacuum Breakers: ASSE 1001.
2. Brass and Copper Supplies: ASME A112.18.1.
3. Dishwasher Air-Gap Fittings: ASSE 1021.
4. Manual-Operation Flushometers: ASSE 1037.
5. Plastic Tubular Fittings: ASTM F 409.
6. Brass Waste Fittings: ASME A112.18.2.
7. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.

K. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Disposers: ASSE 1008 and UL 430.
2. Dishwasher Air-Gap Fittings: ASSE 1021.
3. Flexible Water Connectors: ASME A112.18.6.
4. Floor Drains: ASME A112.6.3.
5. Off-Floor Fixture Supports: ASME A112.6.1M.
6. Pipe Threads: ASME B1.20.1.
7. Plastic Toilet Seats: ANSI Z124.5.
8. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 WARRANTY

A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of whirlpools that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Structural failures of unit shell.
    b. Faulty operation of controls, blowers, pumps, heaters, and timers.
    c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Period for Commercial Applications: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PLUMBING FIXTURES, FAUCETS, HOSE BIBBS

A. Refer to contract drawings for make and model numbers of fixtures, faucets and hose bibbs.

2.2 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Engineered Brass Co.
    b. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
    c. McGuire Manufacturing Co., Inc.
    d. Plumberex Specialty Products Inc.
    e. TCI Products.
    f. TRUEBRO, Inc.
    g. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.
    h. Or Equal.

2. Description: Manufactured plastic wraps for covering plumbing fixture and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

2.3 FIXTURE SUPPORTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Josam Company.
2. MIFAB Manufacturing Inc.
3. Smith, Jay R. Mfg. Co.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
6. Zurn Plumbing Products Group; Specification Drainage Operation.
7. Or Equal.

B. Sink Supports:

1. Description: Type II, sink carrier with hanger plate, bearing studs, and tie rod for sink-type fixture. Include steel uprights with feet.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.

1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

C. Install wall-mounting fixtures with tubular waste piping attached to supports.
D. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.
E. Install counter-mounting fixtures in and attached to casework.
F. Install fixtures level and plumb according to roughing-in drawings.
G. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 15 Section "Valves."

H. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
I. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
J. Install traps on fixture outlets.

1. Exception: Omit trap on fixtures with integral traps.
2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

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. Escutcheons are specified in Division 15050 Section "Basic Mechanical Materials and Methods."
L. Set service basins in leveling bed of cement grout. Grout is specified in Division 15050 Section "Basic Mechanical Materials and Methods."
M. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 7 Section "Joint Sealants."

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
C. Ground equipment according to Division 16 Section "Grounding and Bonding."
D. Connect wiring according to Division 16 Section "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
C. Inspect installed plumbing 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.
E. Install fresh batteries in sensor-operated mechanisms.

3.5 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
B. Operate and adjust disposers. Replace damaged and malfunctioning units.
C. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.
D. Replace washers and seals of leaking and dripping faucets and stops.
E. Install fresh batteries in sensor-operated mechanisms.

3.6 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:

    1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
    2. Remove sediment and debris from drains.

B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

A. Provide protective covering for installed fixtures and fittings.
B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224000

SECTION 224500 - EMERGENCY PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following emergency plumbing fixtures:

1. Eye/face wash equipment.
2. Combination units.

B. Related Sections include the following:

1. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers.
2. Division 22 Section "Sanitary Waste Piping Specialties" for floor drains.
3. Division 22 Section "Domestic Water Filtration Equipment" for water filters.

1.3 DEFINITIONS

A. Accessible Fixture: Emergency plumbing fixture that can be approached, entered, and used by people with disabilities.
B. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable-water supply.
C. Self-Contained Emergency Plumbing Fixture: Fixture with flushing-fluid-solution supply.
D. Tepid: Moderately warm.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include flow rates and capacities, furnished specialties, and accessories.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.
B. ANSI Standard: Comply with ANSI Z358.1, "Emergency Eyewash and Shower Equipment."
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"; for plumbing fixtures for people with disabilities.
D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

PART 2 - PRODUCTS

2.1 COMBINATION UNITS

A. Combination Units, ES/EW-1: Refer to Plumbing Schedule for equipment capacities and characteristics

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

a. Guardian Equipment Co.
b. Haws Corporation.
c. Speakman Company.
d. WaterSaver Faucet Co.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before plumbed emergency plumbing fixture installation.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EMERGENCY PLUMBING FIXTURE INSTALLATION

A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.
B. Install fixtures level and plumb.
C. Fasten fixtures to substrate.
D. Install shutoff valves in water-supply piping to fixtures. Use ball, gate, or globe valve if specific type valve is not indicated. Install valves chained or locked in open position if permitted. Install valves in locations where they can easily be reached for operation. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

1. Exception: Omit shutoff valve on supply to group of plumbing fixtures that includes emergency plumbing fixture.
2. Exception: Omit shutoff valve on supply to emergency equipment if prohibited by authorities having jurisdiction.

E. Install shutoff valve and strainer in steam piping and shutoff valve in condensate return piping.
F. Install dielectric fitting in supply piping to fixture if piping and fixture connections are made of different metals. Dielectric fittings are specified in Division 22 Section "Common Work Results for Plumbing."
G. Install thermometers in supply and outlet piping connections to water-tempering equipment. Thermometers are specified in Division 22 Section "Meters and Gages for Plumbing Piping."
H. Install trap and waste to wall on drain outlet of fixture receptors that are indicated to be directly connected to drainage system.
I. Install indirect waste piping to wall on drain outlet of fixture receptors that are indicated to be indirectly connected to drainage system. Drainage piping is specified in Division 22 Section "Sanitary Waste and Vent Piping."
J. Install escutcheons on piping wall and ceiling penetrations in exposed, finished locations. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."
K. Fill self-contained fixtures with flushing fluid.
L. Install equipment nameplates or equipment markers on fixtures and equipment signs on water-tempering equipment. Identification materials are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Connect cold-water-supply piping to plumbed emergency plumbing fixtures not having water-tempering equipment.
C. Connect hot- and cold-water-supply piping to hot- and cold-water-tempering equipment. Connect output from water-tempering equipment to emergency plumbing fixtures.
D. Connect cold-water and steam supply and condensate return piping to steam and cold-water-tempering equipment. Connect output from water-tempering equipment to emergency plumbing fixtures.
E. Connect cold water and electrical power to electric heating water-tempering equipment.
F. Directly connect emergency plumbing fixture receptors with trapped drain outlet to sanitary drainage and vent piping.
G. Indirectly connect emergency plumbing fixture receptors without trapped drain outlet to sanitary or storm drainage piping.
H. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
I. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Mechanical-Component Testing: After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities and temperatures.
B. Electrical-Component Testing: After electrical circuitry has been energized, test for compliance with requirements.

    1. Test and adjust controls and safeties.

C. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.
D. Report test results in writing.

3.5 ADJUSTING

A. Adjust or replace fixture flow regulators for proper flow.
B. Adjust equipment temperature settings.

END OF SECTION 224500

SECTION 226700 - PROCESSED-WATER SYSTEMS FOR LABORATORY FACILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes deionized-water piping.

1.3 DEFINITIONS

A. CPVC: Chlorinated polyvinyl chloride plastic.
B. PP: Polypropylene plastic.
C. PTFE: Polytetrafluoroethylene plastic.
D. PVC: Polyvinyl chloride plastic.
E. PVDF: Polyvinylidene fluoride plastic.

1.4 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing piping with the following minimum working-pressure ratings, unless otherwise indicated:

1. Deionized-Water Piping: [50 psig (345 kPa)] [100 psig (690 kPa)] [150 psig (1034 kPa)], unless otherwise indicated.

1.5 SUBMITTALS

A. Product Data: For each type of pipe and fitting indicated.
B. Welding certificates.
C. Field quality-control test reports.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing laboratory.
B. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.
C. ASME Compliance: Comply with ASME B31.3, "Process Piping."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic pipe and fittings in direct sunlight.
B. Protect pipe and fittings from dirt and damage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting, and joining materials.
B. Transition Fittings: Couplings, flanges, or other manufactured fittings, same size as, with pressure rating at least equal to and ends compatible with piping to be joined.

2.3 PLASTIC PIPE AND FITTINGS

A. PP Pipe and Fittings: Made from ASTM D 4101, PP resin.

1. Available Manufacturers:

a. Asahi/America.
b. Fischer, George Inc.
c. IPEX Inc.
d. NIBCO INC.
e. Orion.
f. Town & Country Plastics, Inc.

2. Schedule 40, Pipe and Fittings: Pipe made to ASTM D 2447, Schedule 40 dimensions and socket- or butt-fusion fittings matching pipe Schedule 40 dimensions.

2.4 PLASTIC VALVES

A. PP Valves: Made from ASTM D 4101, PP resin.

1. Ball Valves, NPS 2 (DN 50) and Smaller: MSS SP-122, union type with socket ends and pressure rating not less than 150 psig (1035 kPa) at 73 deg F (23 deg C).
2. Check Valves: Swing or ball type with pressure rating not less than 150 psig (1035 kPa) at 73 deg F (23 deg C).

B. PVDF Valves: Made from ASTM D 3222, PVDF resin.

1. Ball Valves, NPS 2 (DN 50) and Smaller: MSS SP-122, union type with socket ends and pressure rating not less than 150 psig (1035 kPa) at 73 deg F (23 deg C).
2. Check Valves: Swing or ball type with pressure rating not less than 150 psig (1035 kPa) at 73 deg F (23 deg C).

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Transition and special fittings with pressure ratings at least equal to and of material same as, or compatible with, piping may be used in applications in this article, unless otherwise indicated.
B. Deionized-Water Piping: Use the following piping materials for each size range:

1. NPS 1 (DN 25) and Smaller: Schedule 40 PP pipe and fittings and heat-fusion joints.
2. NPS 1 (DN 25) and Smaller: Schedule 40 PVDF pipe and fittings and heat-fusion joints.
3. NPS 1-1/4 to NPS 2 (DN 32 to DN 50): Schedule 40 PP pipe and fittings and heat-fusion joints.

3.2 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirement apply:

1. Shutoff Duty: Use ball, diaphragm, or plug valves for NPS 2 (DN 50) and smaller. Use stainless-steel ball, butterfly, diaphragm, or plug valves for NPS 3 (DN 80) and larger.
2. Throttling Duty: Use ball, diaphragm, or plug valves for NPS 2 (DN 50) and smaller. Use stainless-steel ball, butterfly, diaphragm, or plug valves for NPS 3 (DN 80) and larger.

B. Valves for Deionized-Water Piping: Use the following valves for each piping material:

1. PP Pipe and Fittings: PP plastic valves.

3.3 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of deionized-water piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
B. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for general piping installation requirements.

3.4 JOINT CONSTRUCTION

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping joint construction. Where specific joint construction is not indicated, follow piping manufacturer's written instructions.
B. PDVF Piping Joints: Make heat-fusion joints similar to procedure in ASTM D 2657 for polyolefin piping joints.
C. Joint dissimilar pipe materials with transition fittings compatible with pipe materials being joined.

3.5 VALVE INSTALLATION

A. Refer to Division 22 Section "Valves" for general valve installation requirements.
B. Install sectional valves close to mains on each branch and riser serving equipment.
C. Install shutoff valve on each supply to equipment.

3.6 HANGER AND SUPPORT INSTALLATION

A. Seismic-restraint devices are specified in Division 23 Section "Mechanical Vibration and Seismic Controls."
B. Pipe hanger and support devices and installation requirements are specified in Division 22 Section "Hangers and Supports." Install the following:

1. Clamps for Vertical Piping: MSS Type 8 or Type 42.
2. 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.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting, valve, and coupling.
D. Support vertical piping and tubing at base and at each floor.
E. Rod diameter may be reduced 1 size for double-rod hangers, to minimum of 3/8 inch (10 mm).
F. Install padded hangers for PP piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 (DN 32) and Smaller: 30 inches (750 mm) with 3/8-inch (10-mm) rod.
2. NPS 1-1/2 (DN 40): 33 inches (840 mm) with 3/8-inch (10-mm) rod.

G. Install padded supports for vertical PP piping every 42 inches (1800 mm).
H. Install padded supports for vertical PVC piping every 48 inches (1200 mm).
I. Install padded supports for vertical PVDF piping NPS 1-1/2 (DN 40) and smaller every 48 inches (1200 mm) and NPS 2 (DN 50) and larger every 72 inches (1800 mm).

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Install piping adjacent to equipment and machines to allow service and maintenance.
C. Connect deionized-water piping to equipment and service outlets with unions or flanges.

3.8 LABELING AND IDENTIFICATION

A. Install pipe markers and valve tags on piping. Distinguish between different systems and include direction of flow indication on each pipe. Labeling and identification devices are specified in Division 23 Section "Mechanical Identification."

3.9 FIELD QUALITY CONTROL

A. Test new piping, and parts of existing piping that have been altered, extended, or repaired, for leaks and defects.

1. Schedule tests and their inspections by Owner, with at least 24 hours' advance notice.
2. Do not cover or put into service before inspection and approval.
3. Test completed piping according to Owner. If Owner does not have published procedures, perform tests as follows:

    a. Hydrostatic Tests: Test piping at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than [50 psig (345 kPa)] [100 psig (690 kPa)] [150 psig (1035 kPa)] <Insert other>.
    b. Exception: Do not subject glass piping to pressure above manufacturer's pressure rating for size.

4. Replace leaking joints with new materials and retest until no leaks exist.
5. Submit separate reports for each test.

3.10 CLEANING

A. Use procedures prescribed by Owner or, if not prescribed, use procedures described below:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Clean piping by flushing with system deionized water.

END OF SECTION 226700

SECTION 230130.51 - HVAC AIR-DISTRIBUTION SYSTEM CLEANING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes cleaning HVAC air-distribution equipment, ducts, plenums, and system components.

1.3 DEFINITIONS

A. ASCS: Air systems cleaning specialist.

B. NADCA: National Air Duct Cleaners Association.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For an ASCS.

B. Strategies and procedures plan.

C. Cleanliness verification report.

1.5 QUALITY ASSURANCE

A. UL Compliance: Comply with UL 181 and UL 181A for fibrous-glass ducts.

B. Cleaning Conference: Conduct conference at **Project site**.

1. Review methods and procedures related to HVAC air-distribution system cleaning including, but not limited to, review of the cleaning strategies and procedures plan.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine HVAC air-distribution equipment, ducts, plenums, and system components to determine appropriate methods, tools, and equipment required for performance of the Work.

B. Perform "Project Evaluation and Recommendation" according to NADCA ACR 2006.

C. Prepare written report listing conditions detrimental to performance of the Work.

D. Proceed with work only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare a written plan that includes strategies and step-by-step procedures. At a minimum, include the following:

1. Supervisor contact information.
2. Work schedule including location, times, and impact on occupied areas.
3. Methods and materials planned for each HVAC component type.
4. Required support from other trades.
5. Equipment and material storage requirements.
6. Exhaust equipment setup locations.

B. Use the existing service openings, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry and for inspection.

C. Comply with NADCA ACR 2006, "Guidelines for Constructing Service Openings in HVAC Systems" Section.

3.3 CLEANING

A. Comply with NADCA ACR 2006.

B. Remove visible surface contaminants and deposits from within the HVAC system.

C. Systems and Components to Be Cleaned:

1. Air devices for supply and return air.
2. Air-terminal units.
3. Ductwork:

a. Supply-air ducts, including turning vanes, to the air-handling unit.
b. Return-air ducts to the air-handling unit.
c. Exhaust-air ducts.

4. Air-Handling Units:

a. Interior surfaces of the unit casing.
b. Coil surfaces compartment.
c. Condensate drain pans.
d. Fans, fan blades, and fan housings.

5. Filters and filter housings.

D. Collect debris removed during cleaning. Ensure that debris is not dispersed outside the HVAC system during the cleaning process.

E. Particulate Collection:

1. For particulate collection equipment, include adequate filtration to contain debris removed. Locate equipment downwind and away from all air intakes and other points of entry into the building.
2. HEPA filtration with 99.97 percent collection efficiency for particles sized 0.3 micrometer or larger shall be used where the particulate collection equipment is exhausting inside the building,

F. Control odors and mist vapors during the cleaning and restoration process.

G. Mark the position of manual volume dampers and air-directional mechanical devices inside the system prior to cleaning. Restore them to their marked position on completion of cleaning.

H. System components shall be cleaned so that all HVAC system components are visibly clean. On completion, all components must be returned to those settings recorded just prior to cleaning operations.

I. Clean all air-distribution devices, registers, grilles, and diffusers.

J. Clean visible surface contamination deposits according to NADCA ACR 2006 and the following:

1. Clean air-handling units, airstream surfaces, components, condensate collectors, and drains.
2. Ensure that a suitable operative drainage system is in place prior to beginning wash-down procedures.
3. Clean evaporator coils, reheat coils, and other airstream components.

K. Duct Systems:

1. Create service openings in the HVAC system as necessary to accommodate cleaning.
2. Mechanically clean duct systems specified to remove all visible contaminants so that the systems are capable of passing the HVAC System Cleanliness Tests (see NADCA ACR 2006).

L. Debris removed from the HVAC system shall be disposed of according to applicable Federal, state, and local requirements.

M. Mechanical Cleaning Methodology:

1. Source-Removal Cleaning Methods: The HVAC system shall be cleaned using source-removal mechanical cleaning methods designed to extract contaminants from within the HVAC system and to safely remove these contaminants from the facility. No cleaning method, or combination of methods, shall be used that could potentially damage components of the HVAC system or negatively alter the integrity of the system.

    a. Use continuously operating vacuum-collection devices to keep each section being cleaned under negative pressure.
    b. Cleaning methods that require mechanical agitation devices to dislodge debris that is adhered to interior surfaces of HVAC system components shall be equipped to safely remove these devices. Cleaning methods shall not damage the integrity of HVAC system components or damage porous surface materials such as duct and plenum liners.

2. Cleaning Mineral-Fiber Insulation Components:

    a. Fibrous-glass thermal or acoustical insulation elements present in equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment while the HVAC system is under constant negative pressure and shall not be permitted to get wet according to NADCA ACR 2006.
    b. Cleaning methods used shall not cause damage to fibrous-glass components and will render the system capable of passing the HVAC System Cleanliness Tests (see NADCA ACR 2006).
    c. Fibrous materials that become wet shall be discarded and replaced.

N. Coil Cleaning:

1. Measure static-pressure differential across each coil.
2. See NADCA ACR 2006, "Coil Surface Cleaning" Section. Type 1, or Type 1 and Type 2, cleaning methods shall be used to render the coil visibly clean and capable of passing Coil Cleaning Verification (see applicable NADCA ACR 2006).
3. Coil drain pans shall be subject to NADCA ACR 2006, "Non-Porous Surfaces Cleaning Verification." Ensure that condensate drain pans are operational.

4. Electric-resistance coils shall be de-energized, locked out, and tagged before cleaning.
5. Cleaning methods shall not cause any appreciable damage to, cause displacement of, inhibit heat transfer, or cause erosion of the coil surface or fins, and shall comply with coil manufacturer's written recommendations when available.
6. Rinse thoroughly with clean water to remove any latent residues.

O. Antimicrobial Agents and Coatings:

1. Apply antimicrobial agents and coatings if active fungal growth is reasonably suspected or where unacceptable levels of fungal contamination have been verified. Apply antimicrobial agents and coatings according to manufacturer's written recommendations and EPA registration listing after the removal of surface deposits and debris.
2. When used, antimicrobial treatments and coatings shall be applied after the system is rendered clean.
3. Apply antimicrobial agents and coatings directly onto surfaces of interior ductwork.
4. Sanitizing agent products shall be registered by the EPA as specifically intended for use in HVAC systems and ductwork.

3.4 CLEANLINESS VERIFICATION

A. Verify cleanliness according to NADCA ACR 2006, "Verification of HVAC System Cleanliness" Section.

B. Verify HVAC system cleanliness after mechanical cleaning and before applying any treatment or introducing any treatment-related substance to the HVAC system, including biocidal agents and coatings.

C. Perform visual inspection for cleanliness. If no contaminants are evident through visual inspection, the HVAC system shall be considered clean. If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be re-cleaned and subjected to re-inspection for cleanliness.

D. Additional Verification:

1. Perform surface comparison testing or NADCA vacuum test.
2. Conduct NADCA vacuum gravimetric test analysis for nonporous surfaces.

E. Verification of Coil Cleaning:

1. Measure static-pressure differential across each coil.
2. Coil will be considered clean if cleaning restored the coil static-pressure differential within 10 percent of when the coil was first installed.
3. Coil will be considered clean if the coil is free of foreign matter and chemical residue, based on a thorough visual inspection.

F. Prepare a written cleanliness verification report. At a minimum, include the following:

1. Written documentation of the success of the cleaning.
2. Site inspection reports, initialed by supervisor, including notation on areas of inspection, as verified through visual inspection.
3. Surface comparison test results if required.
4. Gravimetric analysis (nonporous surfaces only).
5. System areas found to be damaged.

3.5 RESTORATION

A. Restore and repair HVAC air-distribution equipment, ducts, plenums, and components according to NADCA ACR 2006, "Restoration and Repair of Mechanical Systems" Section.

B. Restore service openings capable of future reopening. Comply with requirements in Section 233113 "Metal Ducts." Include location of service openings in Project closeout report.

C. Replace fibrous-glass materials that cannot be restored by cleaning or resurfacing. Comply with requirements in Section 233113 "Metal Ducts" and Section 233116 "Nonmetal Ducts."

D. Replace damaged insulation according to Section 230713 "Duct Insulation."

E. Ensure that closures do not hinder or alter airflow.

F. New closure materials, including insulation, shall match opened materials and shall have removable closure panels fitted with gaskets and fasteners.

G. Reseal fibrous-glass ducts. Comply with requirements in Section 233116 "Nonmetal Ducts."

END OF SECTION 230130.51

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes 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.

1.3 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

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.
B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet 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.

2.3 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 Smaller than **15** HP: Manufacturer's standard starting characteristic.

2.4 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. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 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 Applicable)

END OF SECTION 230513

SECTION 230516 - EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Flexible-hose packless expansion joints.
   2. Pipe loops and swing connections.
   3. Alignment guides and anchors.

1.3 PERFORMANCE REQUIREMENTS

A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.
B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.
B. Delegated-Design Submittal: For each anchor and alignment guide 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. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
   2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
   3. Alignment Guide Details: Detail field assembly and attachment to building structure.
   4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of expansion joint, from manufacturer.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For expansion joints to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 PACKLESS EXPANSION JOINTS

A. Flexible-Hose Packless Expansion Joints:

1. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
2. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
3. Expansion Joints for Copper Tubing NPS 2 (DN 50) and Smaller: Copper-alloy fittings with **solder-joint** end connections.

a. Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F (3100 kPa at 21 deg C) and 340 psig at 450 deg F (2340 kPa at 232 deg C) ratings.

4. Expansion Joints for Steel PipingNPS 2-1/2 to NPS 6 (DN 65 to DN 150): Carbon-steel fittings with **flanged** end connections.

a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig at 70 deg F (1380 kPa at 21 deg C) and 145 psig at 600 deg F (1000 kPa at 315 deg C) ratings.
b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 275 psig at 70 deg F (1900 kPa at 21 deg C) and 200 psig at 600 deg F (1380 kPa at 315 deg C) ratings.

2.2 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides:

1. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.

B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.

a. Stud: Threaded, zinc-coated carbon steel.
b. Expansion Plug: Zinc-coated steel.
c. Washer and Nut: Zinc-coated steel.

PART 3 - EXECUTION

3.1 EXPANSION-JOINT INSTALLATION

A. Install expansion joints of sizes matching sizes of piping in which they are installed.

3.2 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.
B. Attach guides to pipe and secure guides to building structure.
C. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

END OF SECTION 230516

SECTION 230517 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Sleeves.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

2.2 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
B. Characteristics: Nonshrink; recommended for interior and exterior applications.
C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
B. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. 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 (50 mm)** above finished floor level.

3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

C. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."

D. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.2 SLEEVE SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

a. Piping Smaller Than **NPS 6 (DN 150)**]: **Galvanized-steel-pipe sleeves**

2. Interior Partitions:

a. Piping Smaller Than **NPS 6 (DN 150)**] : **Galvanized-steel-pipe sleeves**

END OF SECTION 230517

SECTION 230518 - ESCUTCHEONS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Escutcheons.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. Split-Casting Brass Type: With **polished, chrome-plated** finish and with concealed hinge and setscrew.

PART 3 - EXECUTION

3.1 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. Bare Piping at Wall and Floor Penetrations in Finished Spaces: **split-casting brass** type with polished, chrome-plated finish.

2. Escutcheons for Existing Piping:
   a. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 230518

SECTION 230519 - METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Filled-system thermometers.
2. Thermowells.
3. Dial-type pressure gages.
4. Gage attachments.
5. Test plugs.
6. Test-plug kits.
7. Ultrasonic, thermal-energy meters.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.
B. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gage, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 FILLED-SYSTEM THERMOMETERS

A. Direct-Mounted, Metal-Case, Vapor-Actuated Thermometers:

1. Standard: ASME B40.200.
2. Case: Sealed type, cast aluminum or drawn steel 6-inch (152-mm) nominal diameter.
3. Element: Bourdon tube or other type of pressure element.
4. Movement: Mechanical, dampening type, with link to pressure element and connection to pointer.
5. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F (deg C).
6. Pointer: Dark-colored metal.
7. Window: Glass .

8. Ring: Stainless steel.
9. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device with ASME B1.1 screw threads.
10. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.

    a. Design for Thermowell Installation: Bare stem.

11. Accuracy: Plus or minus 1 percent of scale range.

2.2 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CRES or CSA .
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, (DN 15, DN 20, or NPS 25,) ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch (13, 19, and 25 mm), with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

2.3 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Standard: ASME B40.100.
2. Case: Sealed type(s); cast aluminum or drawn steel ; 6-inch (152-mm) nominal diameter.
3. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa)
6. Pointer: Dark-colored metal.
7. Window: Glass.
8. Ring: Stainless steel.
9. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range.

2.4 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass, ASME B1.20.1 pipe threads Include extension for use on insulated piping.

2.5 TEST PLUGS

A. Description: Test-station fitting made for insertion into piping tee fitting.
B. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
C. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F (3450 kPa at 93 deg C)
D. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.6 TEST-PLUG KITS

A. Furnish four test-plug kit(s) containing one thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.
B. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- (25- to 51-mm-) diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F (minus 18 to plus 104 deg C)]
C. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch- (51- to 76-mm-) diameter dial and probe. Dial range shall be at least 0 to 200 psig (0 to 1380 kPa.
D. Carrying Case: Metal or plastic, with formed instrument padding.
E. Indicate flowmeter capacity and operating conditions on Drawings.

2.7 THERMAL-ENERGY METERS

A. Ultrasonic, Thermal-Energy Meters:

1. Description: Meter with flow sensor, temperature sensors, transmitter, indicator, and connecting wiring.
2. Flow Sensor: Transit-time ultrasonic type with transmitter.
3. Temperature Sensors: Insertion-type or strap-on transducer.
4. Indicator: Solid-state, integrating-type meter with integral battery pack.

    a. Data Output: Six-digit electromechanical counter with readout in kilowatts per hour or British thermal units (joules).
    b. Battery Pack: Five-year lithium battery.

5. Accuracy: Plus or minus 1 percent.
6. Display: Visually indicates total fluid volume in gallons (liters) and thermal-energy flow in kilowatts per hour or British thermal units (joules).
7. Operating Instructions: Include complete instructions with each thermal-energy meter system.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.
B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
C. Install thermowells with extension on insulated piping.
D. Fill thermowells with heat-transfer medium.
E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.
G. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.
H. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
I. Install remote-mounted pressure gages on panel.
J. Install valve and snubber in piping for each pressure gage for fluids (except steam).
K. Install test plugs in piping tees.
L. Install flow indicators in piping systems in accessible positions for easy viewing.
M. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.
N. Install flowmeter elements in accessible positions in piping systems.
O. Mount thermal-energy meters on wall if accessible; if not, provide brackets to support meters.
P. Install thermometers in the following locations:

1. Inlet and outlet of each hydronic boiler.
2. Inlet and outlet of each thermal-storage tank.

Q. Install pressure gages in the following locations:

1. Discharge of each pressure-reducing valve.
2. Suction and discharge of each pump.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.
B. Connect thermal-energy meter transmitters to meters.

3.3 ADJUSTING

A. After installation, calibrate meters according to manufacturer's written instructions.
B. Adjust faces of meters and gages to proper angle for best visibility.

END OF SECTION 230519

SECTION 230523 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Bronze angle valves.
2. Bronze ball valves.
3. Iron, single-flange butterfly valves.
4. Bronze lift check valves.
5. Bronze swing check valves.
6. Iron swing check valves.

B. Related Sections:

1. Section 230553 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

A. CWP: Cold working pressure.
B. EPDM: Ethylene propylene copolymer rubber.
C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
D. NRS: Nonrising stem.
E. OS&Y: Outside screw and yoke.
F. RS: Rising stem
G. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

1.6 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 angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. 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.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to HVAC valve schedule articles for applications of valves.
B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
C. Valve Sizes: Same as upstream piping unless otherwise indicated.
D. Valve Actuator Types:

1. Handlever: For quarter-turn valves NPS 6 (DN 150) and smaller.

E. Valves in Insulated Piping: With 2-inch (50-mm) stem extensions and the following features:

1. Gate Valves: With rising stem.
2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
3. Butterfly Valves: With extended neck.

2.2 BRONZE ANGLE VALVES

A. Class 125, Bronze Angle Valves with Bronze Disc:

1. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
d. Ends: Threaded.
e. Stem and Disc: Bronze.
f. Packing: Asbestos free.
g. Handwheel: Malleable iron**, bronze, or aluminum**.

B. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).

d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Full.

2.3 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 150 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

1. Description:

a. Standard: MSS SP-67, Type I.
b. CWP Rating: 150 psig (1035 kPa).
c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
e. Seat: EPDM.
f. Stem: One- or two-piece stainless steel.
g. Disc: Aluminum bronze.

2.4 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Description:

a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

2.5 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

1. Description:

a. Standard: MSS SP-71, Type I.
b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).
c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).
d. Body Design: Clear or full waterway.
e. Body Material: ASTM A 126, gray iron with bolted bonnet.
f. Ends: Flanged.
g. Trim: Bronze.
h. Gasket: Asbestos free.

PART 3 - EXECUTION

3.1 EXAMINATION

A. 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.
B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
C. Examine threads on valve and mating pipe for form and cleanliness.
D. 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.
E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
B. Locate valves for easy access and provide separate support where necessary.
C. Install valves in horizontal piping with stem at or above center of pipe.
D. Install valves in position to allow full stem movement.
E. 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.

3.3 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.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball, butterfly valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.

3.5 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Angle Valves: **Class 125**, **bronze** disc.
3. Ball Valves: **Two** piece, **full** port, **brass** with **stainless-steel** trim.
4. Bronze Swing Check Valves: **Class 125**, **bronze** disc.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
2. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): 200 CWP, **EPDM** seat, **stainless-steel** disc.
3. Iron Swing Check Valves: **Class 125** seats.

3.6 LOW-PRESSURE STEAM VALVE SCHEDULE (15 PSIG (104 kPa) OR LESS)

A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze Angle Valves: **Class 125**, **bronze** disc.
2. Ball Valves: **Two** piece, **full** port, **bronze** with **stainless-steel** trim.
3. Bronze Swing Check Valves: **Class 125**, **bronze** disc.

END OF SECTION 230523

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. 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.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

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.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, 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.

2.3 THERMAL-HANGER SHIELD INSERTS

A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) 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-psig (688-kPa) 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 (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.4 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal 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 the building structure.
B. Metal 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 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. 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.
D. Install lateral bracing with pipe hangers and supports to prevent swaying.
E. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
F. 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.
G. 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. 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 (DN 100) 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 (DN 100) and larger if pipe is installed on rollers.

4. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 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 (40 mm)

3.3 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. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.4 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and attachments for general service applications.
F. Use padded hangers for piping that is subject to scratching.
G. Use thermal-hanger shield inserts for insulated piping and tubing.

H. 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. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F (566 deg C), pipes NPS 4 to NPS 24 (DN 100 to DN 600), requiring up to 4 inches (100 mm) of insulation.
3. 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.
4. 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.
5. 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.
6. 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).
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
9. 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).
10. 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).
11. 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).
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 (DN 65 to DN 900) if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. 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.
18. 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.
19. 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 not necessary.
20. 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 not necessary.
21. 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.

I. 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.

J. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F (49 to 232 deg C) piping installations.

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-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

END OF SECTION 230529

SECTION 230548 - VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Isolation pads.
2. Housed spring mounts.
3. Elastomeric hangers.
4. Spring hangers.
5. Restrained vibration isolation roof-curb rails.
6. Steel and inertia, vibration isolation equipment bases.

1.3 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

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 seismic-restraint component used.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details 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. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators, seismic restraints, and for designing vibration isolation bases.

a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.

2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.

3. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
4. Seismic-Restraint Details:

    a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
    b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
    c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (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. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, 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 not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Pads : Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

    1. Resilient Material: Oil- and water-resistant neoprene.

B. Housed Spring Mounts : Housed spring isolator with integral seismic snubbers.

    1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.

2. Base: Factory drilled for bolting to structure.
3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch (6-mm) travel up or down before contacting a resilient collar.

C. Elastomeric Hangers : Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.

D. Spring Hangers : Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of 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. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

2.2 RESTRAINED VIBRATION ISOLATION ROOF-CURB RAILS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
B. General Requirements for Restrained Vibration Isolation Roof-Curb Rails: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment and to withstand seismic forces.
C. Lower Support Assembly: Formed sheet-metal section containing adjustable and removable steel springs that support upper frame. Upper frame shall provide continuous support for equipment and shall be captive to resiliently resist seismic forces. Lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching roof materials, and shall be insulated with a minimum of 2 inches (50 mm) of rigid, glass-fiber insulation on inside of assembly.
D. Spring Isolators: Adjustable, restrained spring isolators shall be mounted on 1/4-inch- (6-mm-) thick, elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.

1. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.

a. Housing: Steel with resilient vertical-limit stops and adjustable equipment mounting and leveling bolt.
b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
d. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

E. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch (6 mm) thick.
F. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counterflashed over roof materials.

2.3 VIBRATION ISOLATION EQUIPMENT BASES

A. Steel Base : Factory-fabricated, welded, structural-steel bases and rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch (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. Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.

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.
4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.4 SEISMIC-RESTRAINT DEVICES

A. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES or 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. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
3. Maximum 1/4-inch (6-mm) air gap, and minimum 1/4-inch- (6-mm-) thick resilient cushion.

C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
D. Restraint Cables: ASTM A 603 galvanized-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
F. 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.
G. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.
H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

I. 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. Minimum length of eight times diameter.

J. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. 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.

2.5 FACTORY FINISHES

A. Finish: Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction.

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 will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

B. 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 agency acceptable to authorities having jurisdiction providing required submittals for component.

C. Piping Restraints:

1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet (12 m) o.c., and longitudinal supports a maximum of 80 feet (24 m) o.c.
3. Brace a change of direction longer than 12 feet (3.7 m).

D. Install cables so they do not bend across edges of adjacent equipment or building structure.
E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
F. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
G. 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.
H. 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.
I. 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.

3.4 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 232116 Hydronic Piping Specialties" for piping flexible connections.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
B. Perform tests and inspections.
C. 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 postconnection 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 at least four of 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. Verify snubber minimum clearances.

9. Air-Mounting System Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
10. Air-Mounting System Operational Test: Test the compressed-air leveling system.
11. Test and adjust air-mounting system controls and safeties.
12. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

D. Remove and replace malfunctioning units and retest as specified above.
E. Prepare test and inspection reports.

3.6 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.
C. Adjust air-spring leveling mechanism.
D. Adjust active height of spring isolators.
E. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-mounting systems. Refer to Section 017900 "Demonstration and Training."

END OF SECTION 230548

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Pipe labels.
3. Valve tags.
4. Ceiling grid, access panel, and door markers.
5. Damper ribbons.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
B. Coordinate installation of identifying devices with locations of access panels and doors.
C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:
B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) 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: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. 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), plus the Specification Section number and title where equipment is specified.

2.2 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
B. Pre-tensioned Pipe Labels: Pre-coiled, semi-rigid 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 1-1/2 inches (38 mm) high.

2.3 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.

1. Tag Material: Brass, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.4 DUCT IDENTIFICATION DEVICES

A. Damper Ribbons: Plastic ribbon or tape. 3/4 Inch width minimum. Red or yellow.

2.5 CEILING GRID, ACCESS PANEL, AND DOOR MARKERS

A. Color coded dots: ¼ inch, self-adhering.

PART 3 - EXECUTION

3.1 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.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.
B. Locate equipment labels where accessible and visible.

3.3 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 (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

B. Pipe Label Color Schedule:

1. Heating Water Piping:

a. Background Color: Red.
b. Letter Color: White.

2. Refrigerant Piping:

a. Background Color: Black.
b. Letter Color: White.

3.4 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 HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

a. Refrigerant: 1-1/2 inches (38 mm).
b. Hot Water: 1-1/2 inches (38 mm).
c. Gas: 1-1/2 inches (38 mm).

2. Valve-Tag Color:

a. Refrigerant: Natural.
b. Hot Water: Natural.
c. Gas: Natural.

3. Letter Color:

a. Refrigerant: Black.

b. Hot Water: Black.
c. Gas: Black.

3.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

3.6 DUCT IDENTIFICATION

A. All duct dampers that will be located above a ceiling will have an identification ribbon tied to the damper handle. The ribbon is to hang down at least 12 inches below the bottom of the duct or to the level of the ceiling; whichever is shorter.

3.7 CEILING GRID, ACCESS PANEL, AND DOOR MARKERS

A. Provide ¼" self-adhering color coded dots to the ceiling grid and access doors. Color code is as follows:

1. Blue – HVAC. Includes fire/smoke dampers, energy management system (EMS) controls, control or modulating dampers, in-line fans, steam traps, fan coils, air vents, etc. Does not apply to fixed position balancing dampers.
2. Green – plumbing. Applies to cleanouts, drains, isolation valves, etc.

B. Installation; locate dots on following locations;

1. For T-bar ceilings, locate dot at the intersection of the grid. Dot is to be placed towards the tile that should be removed to gain access to the device. This does not necessarily mean that it is the tile directly below the item being identified.
2. For access doors, place dots on door for all services being identified (red, blue and/or green).

3.8 ADJUSTING

A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Balancing Air Systems:

a. Constant-volume air systems.
b. Variable-air-volume systems.

2. Balancing Hydronic Piping Systems:

a. Constant-flow hydronic systems.
b. Variable-flow hydronic systems.
c. Primary-secondary hydronic systems.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.
B. NEBB: National Environmental Balancing Bureau.
C. TAB: Testing, adjusting, and balancing.
D. TABB: Testing, Adjusting, and Balancing Bureau.
E. TAB Specialist: An entity engaged to perform TAB Work.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 15 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
B. Contract Documents Examination Report: Within 15 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. Certified TAB reports.
E. Sample report forms.
F. 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.

1.5 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC, NEBB, or TABB.

1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC, NEBB, or TABB.
2. TAB Technician: Employee of the TAB contractor and who is certified by AABC, NEBB, or TABB. as a TAB technician.

B. TAB Conference: Meet with Construction Manager and Commissioning Authority on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items:

a. The Contract Documents examination report.
b. The TAB plan.
c. Coordination and cooperation of trades and subcontractors.
d. Coordination of documentation and communication flow.

C. Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

D. TAB Report Forms: Use standard TAB contractor's forms approved by AABC, NEBB, or TABB.
E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."
F. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
G. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.6 PROJECT CONDITIONS

A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 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 systems for installed 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 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 meet the leakage class of connected ducts as specified in Section 233113 "Metal Ducts" and Section 233116 "Nonmetal Ducts" and 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 and pump 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 filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
K. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
L. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
N. Examine system pumps to ensure absence of entrained air in the suction piping.
O. Examine operating safety interlocks and controls on HVAC equipment.
P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare reports. Verify the following:

1. Permanent electrical-power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in ASHRAE 111 and SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.

1. Comply with requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

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).

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
B. Prepare schematic diagrams of systems' "as-built" duct layouts.
C. For variable-air-volume systems, develop a plan to simulate diversity.
D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
E. Check airflow patterns from the 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."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

2. Measure fan static pressures as follows to determine actual static pressure:

a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
b. Measure static pressure directly at the fan outlet or through the flexible connection.
c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

a. Report the cleanliness status of filters and the time static pressures are measured.

4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
6. Obtain approval from Engineer of Record 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.
7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow of submain and branch ducts.

a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
3. Measure total system airflow. Adjust to within indicated airflow.

4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.

    a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.

6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

    a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
8. Record final fan-performance data.

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
B. Prepare schematic diagrams of systems' "as-built" piping layouts.
C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.
2. Check liquid level in expansion tank.
3. Check makeup water-station pressure gage for adequate pressure for highest vent.
4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.8 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:

1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.

    a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Engineer of Record and comply with requirements in Section 232123 "Hydronic Pumps."

2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.

a. Monitor motor performance during procedures and do not operate motors in overload conditions.

3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
4. Report flow rates that are not within plus or minus 10 percent of design.

B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.
C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.
D. Set balancing valves, if installed, at calculated presettings.
E. Measure flow at all stations and adjust, where necessary, to obtain first balance.

1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:

1. Determine the balancing station with the highest percentage over indicated flow.
2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
3. Record settings and mark balancing devices.

H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.
J. Check settings and operation of each safety valve. Record settings.

3.9 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.10 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

A. Balance the primary circuit flow first and then balance the secondary circuits.

3.11 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. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.12 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.
B. Measure entering- and leaving-air temperatures.
C. Record compressor data.

3.13 PROCEDURES FOR BOILERS

A. Hydronic Boilers: Measure and record entering- and leaving-water temperatures and water flow.

B. Steam Boilers: Measure and record entering-water temperature and flow and leaving-steam pressure, temperature, and flow.

3.14 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

B. Measure, adjust, and record the following data for each electric heating coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load and at each incremental stage.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. Measure, adjust, and record the following data for each steam coil:

1. Dry-bulb temperature of entering and leaving air.
2. Airflow.
3. Air pressure drop.
4. Inlet steam pressure.

D. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.15 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 air flow 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.

3.16 TOLERANCES

A. Set HVAC system's air flow 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.
3. Heating-Water Flow Rate: Plus or minus 10 percent.

3.17 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: Prepare biweekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.18 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.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; 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 contractor.
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 and pump 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. Air-Handling-Unit Test Reports: For air-handling 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 air flow 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. Preheat-coil static-pressure differential in inches wg (Pa).
    g. Cooling-coil static-pressure differential in inches wg (Pa).
    h. Heating-coil static-pressure differential in inches wg (Pa).
    i. Outdoor airflow in cfm (L/s).
    j. Return airflow in cfm (L/s).
    k. Outdoor-air damper position.
    l. 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. Air flow 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. Water flow rate in gpm (L/s).
i. Water pressure differential in feet of head or psig (kPa).
j. Entering-water temperature in deg F (deg C).
k. Leaving-water temperature in deg F (deg C).
l. Refrigerant expansion valve and refrigerant types.
m. Refrigerant suction pressure in psig (kPa).
n. Refrigerant suction temperature in deg F (deg C).

G. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Fuel type in input data.
g. Output capacity in Btu/h (kW).
h. Ignition type.
i. Burner-control types.
j. Motor horsepower and rpm.
k. Motor volts, phase, and hertz.
l. Motor full-load amperage and service factor.
m. Sheave make, size in inches (mm), and bore.
n. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).

2. Test Data (Indicated and Actual Values):

a. Total air flow rate in cfm (L/s).
b. Entering-air temperature in deg F (deg C).
c. Leaving-air temperature in deg F (deg C).
d. Air temperature differential in deg F (deg C).
e. Entering-air static pressure in inches wg (Pa).
f. Leaving-air static pressure in inches wg (Pa).
g. Air static-pressure differential in inches wg (Pa).
h. Low-fire fuel input in Btu/h (kW).
i. High-fire fuel input in Btu/h (kW).
j. Manifold pressure in psig (kPa).
k. High-temperature-limit setting in deg F (deg C).
l. Operating set point in Btu/h (kW).
m. Motor voltage at each connection.
n. Motor amperage for each phase.
o. Heating value of fuel in Btu/h (kW).

H. 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).

I. 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 air flow rate in cfm (L/s).
    h. Indicated velocity in fpm (m/s).
    i. Actual air flow rate in cfm (L/s).
    j. Actual average velocity in fpm (m/s).
    k. Barometric pressure in psig (Pa).

J. Air-Terminal-Device Reports:

1. Unit Data:

    a. System and air-handling unit identification.
    b. Location and zone.
    c. Apparatus used for test.
    d. Area served.
    e. Make.
    f. Number from system diagram.
    g. Type and model number.
    h. Size.
    i. Effective area in sq. ft. (sq. m).

2. Test Data (Indicated and Actual Values):

    a. Air flow rate in cfm (L/s).
    b. Air velocity in fpm (m/s).
    c. Preliminary air flow rate as needed in cfm (L/s).
    d. Preliminary velocity as needed in fpm (m/s).
    e. Final air flow rate in cfm (L/s).
    f. Final velocity in fpm (m/s).
    g. Space temperature in deg F (deg C).

K. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

    a. System and air-handling-unit identification.
    b. Location and zone.
    c. Room or riser served.
    d. Coil make and size.
    e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

    a. Air flow rate in cfm (L/s).
    b. Entering-water temperature in deg F (deg C).
    c. Leaving-water temperature in deg F (deg C).
    d. Water pressure drop in feet of head or psig (kPa).
    e. Entering-air temperature in deg F (deg C).
    f. Leaving-air temperature in deg F (deg C).

L. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:

    a. Unit identification.
    b. Location.
    c. Service.
    d. Make and size.
    e. Model number and serial number.
    f. Water flow rate in gpm (L/s).
    g. Water pressure differential in feet of head or psig (kPa).
    h. Required net positive suction head in feet of head or psig (kPa).
    i. Pump rpm.
    j. Impeller diameter in inches (mm).
    k. Motor make and frame size.
    l. Motor horsepower and rpm.
    m. Voltage at each connection.
    n. Amperage for each phase.
    o. Full-load amperage and service factor.
    p. Seal type.

2. Test Data (Indicated and Actual Values):

    a. Static head in feet of head or psig (kPa).
    b. Pump shutoff pressure in feet of head or psig (kPa).
    c. Actual impeller size in inches (mm).
    d. Full-open flow rate in gpm (L/s).
    e. Full-open pressure in feet of head or psig (kPa).
    f. Final discharge pressure in feet of head or psig (kPa).
    g. Final suction pressure in feet of head or psig (kPa).
    h. Final total pressure in feet of head or psig (kPa).
    i. Final water flow rate in gpm (L/s).
    j. Voltage at each connection.
    k. Amperage for each phase.

M. Instrument Calibration Reports:

1. Report Data:

    a. Instrument type and make.

b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.19 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:

a. Measure airflow of at least 10 percent of air outlets.
b. Measure water flow of at least 5 percent of terminals.
c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
d. Verify that balancing devices are marked with final balance position.
e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect and Commissioning Authority.
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Architect and/or Commissioning Authority.
3. Architect and/or Commissioning Authority shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

3.20 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230713 – DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Insulation Materials:
   a. Flexible elastomeric.
   b. Mineral fiber.
2. Insulating cements.
3. Adhesives.
4. Mastics.
5. Lagging adhesives.
6. Sealants.
7. Factory-applied jackets.
8. Field-applied jackets.
9. Tapes.
10. Securements.
11. Corner angles.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
B. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.
8. Detail field application for each equipment type.

C. Qualification Data: For qualified Installer.
D. 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.
E. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 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.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
C. Coordinate installation and testing of heat tracing.

1.7 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

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Aeroflex USA Inc.; Aerocel.
b. Armacell LLC; AP Armaflex.
c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. CertainTeed Corp.; Duct Wrap.
b. Johns Manville; Microlite.
c. Knauf Insulation; Duct Wrap.
d. Manson Insulation Inc.; Alley Wrap.
e. Owens Corning; All-Service Duct Wrap.

H. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Fibrex Insulations Inc.; Coreplus 1200.
b. Johns Manville; Micro-Lok.
c. Knauf Insulation; 1000 Pipe Insulation.
d. Manson Insulation Inc.; Alley-K.
e. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F (454 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

2.3 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. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F (10 to 427 deg C).

1. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. PVC Jacket Adhesive: Compatible with PVC jacket.

1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.
D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

2.5 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, equipment, and pipe insulation.
2. Service Temperature Range: Minus 50 to plus 180 deg F (Minus 46 to plus 82 deg C).

2.6 SEALANTS

A. Joint Sealants:
B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Products, Division of ITW; CP-76-8.
b. Foster Products Corporation, H. B. Fuller Company; 95-44.
c. Marathon Industries, Inc.; 405.
d. Mon-Eco Industries, Inc.; 44-05.
e. Vimasco Corporation; 750.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: Aluminum.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Products, Division of ITW; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: White.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
3. PVDC Jacket for Indoor Applications: 4-mil- (0.10-mm-) thick, white PVDC bi-axially oriented barrier film with a permeance at 0.02 perms (0.013 metric perms) when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
4. PVDC Jacket for Outdoor Applications: 6-mil- (0.15-mm-) thick, white PVDC bi-axially oriented barrier film with a permeance at 0.01 perms (0.007 metric perms) when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.

2.8 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Adhesive: As recommended by jacket material manufacturer.
2. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

D. Metal Jacket:

1. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005, Temper H-14.
   a. Factory-Fabricated Fitting Covers:

      1) Same material, finish, and thickness as jacket.
      2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      3) Tee covers.
      4) Flange and union covers.
      5) End caps.
      6) Beveled collars.
      7) Valve covers.
      8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

E. Self-Adhesive Outdoor Jacket: 60-mil- (1.5-mm-) thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered with aluminum-foil facing.

F. PVDC Jacket for Indoor Applications: 4-mil- (0.10-mm-) thick, white PVDC bi-axially oriented barrier film with a permeance at 0.02 perms (0.013 metric perms) when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.

G. PVDC Jacket for Outdoor Applications: 6-mil- (0.15-mm-) thick, white PVDC bi-axially oriented barrier film with a permeance at 0.01 perms (0.007 metric perms) when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.

2.9 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

E. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.

F. PVDC Tape for Outdoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.

2.10 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- (2.6-mm-) 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- (2.6-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
    a. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

    a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

C. Wire: 0.062-inch (1.6-mm) soft-annealed, stainless steel.

2.11 CORNER ANGLES

A. PVC Corner Angles: 30 mils (0.8 mm) thick, minimum 1 by 1 inch (25 by 25 mm), PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm), aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005; Temper H-14.

C. Stainless-Steel Corner Angles: 0.024 inch (0.61 mm) thick, minimum 1 by 1 inch (25 by 25 mm), stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils (0.127 mm) thick and an epoxy finish 5 mils (0.127 mm) thick if operating in a temperature range between 140 and 300 deg F (60 and 149 deg C). Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
E. Install multiple layers of insulation with longitudinal and end seams staggered.
F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
G. Keep insulation materials dry during application and finishing.
H. Install insulation with tight longitudinal seams and end joints. 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) o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and 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.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches (50 mm).

1. Comply with requirements in Division 07 Section "Penetration Fire-stopping" fire-stopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches (50 mm).
2. Pipe: Install insulation continuously through floor penetrations.
3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Fire-stopping."

3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:

    a. Do not weld anchor pins to ASME-labeled pressure vessels.
    b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
    c. On tanks and vessels, maximum anchor-pin spacing is 3 inches (75 mm) from insulation end joints, and 16 inches (400 mm) o.c. in both directions.
    d. Do not over compress insulation during installation.
    e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
    f. Impale insulation over anchor pins and attach speed washers.
    g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch pre-stressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches (150 mm) from each end. Install wire or cable between two circumferential girdles 12 inches (300 mm) o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch pre-stressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches (1200 mm) o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches (75 mm).
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.

10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
2. Seal longitudinal seams and end joints.

3.6 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, vessels, and equipment. 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.

3.7 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

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 Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

E. Blanket Insulation Installation on Ducts and Plenums: Secure with 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 (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
    b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) 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 (50 mm) from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) 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 (10 deg C) at 18-foot (5.5-m) 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 2 times the insulation thickness but not less than 3 inches (75 mm).

5. Overlap un-faced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm) 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- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

F. Board 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 (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
    b. On duct sides with dimensions larger than 18 inches (450 mm), space pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) 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. 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 (50 mm) from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) 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 (10 deg C) at 18-foot (5.5-m) 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 2 times the insulation thickness but not less than 3 inches (75 mm).
5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

3.9 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 FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.

2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. 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.

D. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

E. Where PVDC jackets are indicated, install as follows:

1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
2. Wrap factory-pre-sized jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install pre-sized jacket with an approximate overlap at butt joint of 2 inches (50 mm) over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches (850 mm) or less. The 33-1/2-inch- (850-mm-) circumference limit allows for 2-inch- (50-mm-) overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fish-mouthing," and use PVDC tape along lap seal to secure joint.
5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
B. Perform tests and inspections.
C. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
2. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
3. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.11 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and return air.

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.

3.12 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed supply-air duct insulation shall be the following:

1. Mineral-Fiber Blanket: Minimum R4.2 Thermal Performance

3.13 EQUIPMENT INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.
B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.
C. Heating-hot-water pump insulation shall be the following:

1. Cellular Glass: 3 inches (75 mm) thick.

D. Heating-hot-water expansion/compression tank insulation shall be the following:

1. Cellular Glass: 1-1/2 inches (38 mm) thick.

E. Heating-hot-water air-separator insulation shall be one of the following:

1. Cellular Glass: 3 inches (75 mm) thick.
2. Mineral-Fiber Pipe and Tank: 2 inches (50 mm) thick.

3.14 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.
B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.15 PIPING INSULATION SCHEDULE

A. Heating-Hot-Water Supply and Return, 200 Deg F (93 Deg C) and below:

1. NPS 3/4 and Larger: Insulation shall be the following:

B. Mineral-Fiber, Preformed Pipe, Type I. 1-1/2-inch thick at the conductivity range 0.25-0.29 btu/(sf*degF) Refrigerant Suction:

1. All Pipe Sizes: Insulation shall meet Title-24 energy requirements; Conductivity 0.23-0.27 and be one of the following:
   a. Flexible Elastomeric: Thickness as required by Title-24 energy requirements.
   b. Mineral-Fiber, Preformed Pipe Insulation, Type I: Thickness as required by Title-24 energy requirements.

3.16 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. If more than one material is listed, selection from materials listed is Contractor's option.
B. Piping:

1. Heating hot water piping located in the boiler and utility room shall be provided with blue jacketing.

3.17 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:

1. PVC
2. Aluminum

END OF SECTION 230700

SECTION 230716 - HVAC EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes insulating the following HVAC equipment that is not factory insulated:
   1. Heating, hot-water pumps.
   2. Expansion/compression tanks.
   3. Air separators.
   4. Thermal storage tanks.

1.3 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 attachment and covering of heat tracing inside insulation.
   3. Detail removable insulation at equipment connections.
   4. Detail application of field-applied jackets.
   5. Detail application at linkages of control devices.
   6. Detail field application for each equipment type.

1.4 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.

1.5 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.

1.6 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.

1.7 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 equipment Installer for equipment insulation application.
C. Coordinate installation and testing of heat tracing.

1.8 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

2.1 INSULATION MATERIALS

A. Comply with requirements in "Breeching Insulation Schedule" and "Equipment 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. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Block Insulation: ASTM C 552, Type I.
2. Special-Shaped Insulation: ASTM C 552, Type III.
3. Board Insulation: ASTM C 552, Type IV.
4. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
H. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.
I. Polystyrene: Rigid, extruded cellular polystyrene intended for use as thermal insulation. Comply with ASTM C 578, Type IV or Type XIII, except thermal conductivity (k-value) shall not exceed 0.26 Btu x in./h x sq. ft. x deg F (0.038 W/m x K) after 180 days of aging. Fabricate shapes according to ASTM C 450 and ASTM C 585.

2.2 INSULATING CEMENTS

A. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

2.3 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. Phenolic and Polyisocyanurate Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F (minus 59 to plus 149 deg C).

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. 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. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-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: 60 percent by volume and 66 percent by weight.
4. Color: White.

2.5 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
b. Eagle Bridges - Marathon Industries; 405.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
d. Mon-Eco Industries, Inc.; 44-05.
e. Pittsburgh Corning Corporation; Pittseal 444.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
5. Color: White or gray.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. FSK and Metal 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: Aluminum.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. 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.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
2. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
3. PVDC Jacket for Outdoor Applications: 6-mil- (0.15-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perm (0.007 metric perm) when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
4. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms (0.86 metric perm) when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Adhesive: As recommended by jacket material manufacturer.
2. Color: Color as selected by Architect.
3. Factory-fabricated tank heads and tank side panels.

D. Metal Jacket:

1. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.

a. Sheet and roll stock ready for shop or field sizing.
b. Finish and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
d. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.
2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.

a. Sheet and roll stock ready for shop or field sizing.
b. Material, finish, and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
d. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.

2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

E. PVDC Jacket for Outdoor Applications: 6-mil- (0.15-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perm (0.007 metric perm) when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.

2.8 TAPES

A. PVDC Tape for Outdoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.

1. Width: 3 inches (75 mm).
2. Film Thickness: 6 mils (0.15 mm).
3. Adhesive Thickness: 1.5 mils (0.04 mm).
4. Elongation at Break: 145 percent.
5. Tensile Strength: 55 lbf/inch (10.1 N/mm) in width.

2.9 SECUREMENTS

A. Bands:

1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304; 0.015 inch (0.38 mm) thick, 1/2 inch (13 mm) wide with wing seal or closed seal.
2. 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 (13 mm) wide with wing seal or closed seal.
3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) 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- (2.6-mm-)] [0.135-inch- (3.5-mm-)] diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.
3. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, aluminum or stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

    a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.
D. Wire: 0.062-inch (1.6-mm) soft-annealed, stainless steel.

2.10 CORNER ANGLES

A. PVC Corner Angles: 30 mils (0.8 mm) thick, minimum 1 by 1 inch (25 by 25 mm), PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm), aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14.
C. Stainless-Steel Corner Angles: 0.024 inch (0.61 mm) thick, minimum 1 by 1 inch (25 by 25 mm), stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304.

PART 3 - EXECUTION

3.1 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 and equipment 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.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils (0.127 mm) thick and an epoxy finish 5 mils (0.127 mm) thick if operating in a temperature range between 140 and 300 deg F (60 and 149 deg C). Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F (0 and 149 deg C) with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment.
B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment 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.
4. Cover inserts with jacket material matching adjacent insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

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- (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). 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.

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 (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

O. 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.

3.4 INSTALLATION OF EQUIPMENT, TANK, AND VESSEL INSULATION

A. Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:

    a. Do not weld anchor pins to ASME-labeled pressure vessels.
    b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
    c. On tanks and vessels, maximum anchor-pin spacing is 3 inches (75 mm) from insulation end joints, and 16 inches (400 mm) o.c. in both directions.

d. Do not overcompress insulation during installation.
e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
f. Impale insulation over anchor pins and attach speed washers.
g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches (150 mm) from each end. Install wire or cable between two circumferential girdles 12 inches (300 mm) o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches (1200 mm) o.c. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches (75 mm).
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
2. Seal longitudinal seams and end joints.

C. Insulation Installation on Pumps:

1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch (150-mm) centers, starting at corners. Install 3/8-inch- (10-mm-) diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
2. Fabricate boxes from aluminum or stainless steel, at least 0.040 inch (1.0 mm) thick.
3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.5 FIELD-APPLIED JACKET INSTALLATION

A. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. 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.

B. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

C. Where PVDC jackets are indicated, install as follows:

1. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches (850 mm) or less. 33-1/2-inch- (850-mm-) circumference limit allows for 2-inch- (50-mm-) overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
2. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.6 FINISHES

A. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
B. Do not field paint aluminum or stainless-steel jackets.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
B. Perform tests and inspections.
C. Tests and Inspections: Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one] <Insert number> location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.8 EQUIPMENT INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.
B. Insulate indoor and outdoor equipment that is not factory insulated.
C. Heating-hot-water pump insulation shall be one of the following:

1. Cellular Glass: 3 inches (75 mm) thick.

D. Heating-hot-water expansion/compression tank insulation shall be the following:

1. Cellular Glass: 1-1/2 inches (38 mm) thick.

E. Heat-recovery expansion/compression tank insulation shall be the following:

1. Cellular Glass: 1-1/2 inches (38 mm) thick.

F. Heating-hot-water air-separator insulation shall be the following:

1. Cellular Glass: 3 inches (75 mm) thick.

G. Thermal storage tank (water) insulation shall be the following:

1. Cellular Glass: 4 inches (100 mm) thick.

3.9 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. Equipment, Exposed,:

1. Painted Aluminum, Stucco Embossed: 0.032 inch (0.81 mm) thick.
2. Stainless Steel, Type 304, Stucco Embossed: 0.020 inch (0.51 mm) thick.

END OF SECTION 230716

SECTION 230719 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes insulating the following HVAC piping systems:
   1. Heating hot-water piping, indoors and outdoors.
   2. Steam and steam condensate piping, outdoors.
   3. Refrigerant suction and hot-gas piping, indoors and outdoors.

1.3 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).

1.4 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.

1.5 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.

1.6 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.

1.7 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.

1.8 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

2.1 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. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Block Insulation: ASTM C 552, Type I.
2. Special-Shaped Insulation: ASTM C 552, Type III.
3. Board Insulation: ASTM C 552, Type IV.
4. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
5. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
6. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

G. Mineral-Fiber, Preformed Pipe Insulation:

1. Type I, 850 deg F (454 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

2.3 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. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F (minus 73 to plus 93 deg C).

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

F. PVC Jacket Adhesive: Compatible with PVC jacket.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor 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: Solvent based; suitable for outdoor use on below-ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
2. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
3. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
4. Color: White.

D. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-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: 60 percent by volume and 66 percent by weight.
4. Color: White.

2.5 SEALANTS

A. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
4. Color: White or gray.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. FSK and Metal 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: Aluminum.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. 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.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
5. PVDC Jacket for Indoor Applications: 4-mil- (0.10-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perm (0.013 metric perm) when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.

6. PVDC Jacket for Outdoor Applications: 6-mil- (0.15-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perm (0.007 metric perm) when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.

7. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.

8. Vinyl Jacket: White vinyl with a permeance of 1.3 perms (0.86 metric perms) when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Adhesive: As recommended by jacket material manufacturer.
2. Color: Color as selected by Architect.
3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

    a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

D. Metal Jacket:

1. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.

    a. Sheet and roll stock ready for shop or field sizing.
    b. Finish and thickness are indicated in field-applied jacket schedules.
    c. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
    d. Factory-Fabricated Fitting Covers:

        1) Same material, finish, and thickness as jacket.
        2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
        3) Tee covers.
        4) Flange and union covers.
        5) End caps.
        6) Beveled collars.
        7) Valve covers.
        8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.

    a. Sheet and roll stock ready for shop or field sizing.
    b. Material, finish, and thickness are indicated in field-applied jacket schedules.
    c. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
    d. Factory-Fabricated Fitting Covers:

        1) Same material, finish, and thickness as jacket.
        2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
        3) Tee covers.
        4) Flange and union covers.
        5) End caps.
        6) Beveled collars.
        7) Valve covers.
        8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.8 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Width: 3 inches (75 mm).
2. Thickness: 11.5 mils (0.29 mm).
3. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Width: 2 inches (50 mm).
2. Thickness: 3.7 mils (0.093 mm).
3. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
4. Elongation: 5 percent.
5. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.9 SECUREMENTS

A. Bands:

1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304; 0.015 inch (0.38 mm) thick, 1/2 inch (13 mm) wing seal or closed seal.
2. 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 (13 mm)] [3/4 inch (19 mm)] wide with wing seal or closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

C. Wire: 0.062-inch (1.6-mm) soft-annealed, stainless steel (Outdoors); 0.062-inch (1.6-mm) soft-annealed, galvanized steel (Indoors).

PART 3 - EXECUTION

3.1 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.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils (0.127 mm) thick and an epoxy finish 5 mils (0.127 mm) thick if operating in a temperature range between 140 and 300 deg F (60 and 149 deg C). Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F (0 and 149 deg C) with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of 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.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. 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."

3.5 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.

3.6 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches (150 mm) o.c.

4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.7 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 Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.9 FIELD-APPLIED JACKET INSTALLATION

A. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

3.10 FINISHES

A. Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

C. Do not field paint aluminum or stainless-steel jackets.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to twenty locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.12 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.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.13 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. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch (13 mm) thick.

B. Heating-Hot-Water Supply and Return, 200 Deg F (93 Deg C) and Below:

1. Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe, Type I: Submitted insulation shall meet Title-24 minimum insulation standards as noted below. Insulation shall maintain a conductivity as noted in the table. In addition, the insulation thickness shall vary per the table.

FLUID TEMPERATURE RANGE (°F)	CONDUCTIVITY RANGE (in Btu-inch per hour per square foot per °F)	INSULATION MEAN RATING TEMPERATURE (°F)	NOMINAL PIPE DIAMETER (in inches)				
			<1	1 to <1.5	1.5 to <4	4 to <8	≥8
			INSULATION THICKNESS REQUIRED (in inches)				
Space heating and service water heating systems (steam, steam condensate and hot water);							
Above 350	0.32-0.34	250	4.5	5.0	5.0	5.0	5.0
251-350	0.29-0.32	200	3.0	4.0	4.5	4.5	4.5
201-250	0.27-0.30	150	2.5	2.5	2.5	3.0	3.0
141-200	0.25-0.29	125	1.5	1.5	2.0	2.0	2.0
105-140	0.22-0.28	100	1.0	1.5	1.5	1.5	1.5
Space cooling systems (chilled water, refrigerant and brine)							
			Nonres	Res	Nonres	Res	
40-60	0.21-0.27	75	0.5	0.75	0.5	0.75	1.0	1.0	1.0
Below 40	0.20-0.26	50	1.0		1.5		1.5	1.5	1.5

C. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be the following:
   a. Mineral-Fiber, Preformed Pipe, Type I: Submitted insulation shall meet Title-24 minimum insulation standards as noted below. Insulation shall maintain a conductivity as noted in the table. In addition, the insulation thickness shall vary per the table.

FLUID TEMPERATURE RANGE (°F)	CONDUCTIVITY RANGE (in Btu-inch per hour per square foot per °F)	INSULATION MEAN RATING TEMPERATURE (°F)	NOMINAL PIPE DIAMETER (in inches)				
			<1	1 to <1.5	1.5 to <4	4 to <8	≥8
			INSULATION THICKNESS REQUIRED (in inches)				
Space heating and service water heating systems (steam, steam condensate and hot water);							
Above 350	0.32-0.34	250	4.5	5.0	5.0	5.0	5.0
251-350	0.29-0.32	200	3.0	4.0	4.5	4.5	4.5
201-250	0.27-0.30	150	2.5	2.5	2.5	3.0	3.0
141-200	0.25-0.29	125	1.5	1.5	2.0	2.0	2.0
105-140	0.22-0.28	100	1.0	1.5	1.5	1.5	1.5
Space cooling systems (chilled water, refrigerant and brine)							
			Nonres	Res	Nonres	Res	
40-60	0.21-0.27	75	0.5	0.75	0.5	0.75	1.0	1.0	1.0
Below 40	0.20-0.26	50	1.0		1.5		1.5	1.5	1.5

   b.

3.14 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Heating-Hot-Water Supply and Return, 200 Deg F (93 Deg C) and Below:

1. All Pipe Sizes: Insulation shall be the following:
   a. Cellular Glass: Submitted insulation shall meet Title-24 minimum insulation standards as noted below. Insulation shall maintain a conductivity as noted in the table. In addition, the insulation thickness shall vary per the table.

b.

FLUID TEMPERATURE RANGE (°F)	CONDUCTIVITY RANGE (in Btu-inch per hour per square foot per °F)	INSULATION MEAN RATING TEMPERATURE (°F)	NOMINAL PIPE DIAMETER (in inches)				
			<1	1 to <1.5	1.5 to <4	4 to <8	≥8
			INSULATION THICKNESS REQUIRED (in inches)				
Space heating and service water heating systems (steam, steam condensate and hot water);							
Above 350	0.32-0.34	250	4.5	5.0	5.0	5.0	5.0
251-350	0.29-0.32	200	3.0	4.0	4.5	4.5	4.5
201-250	0.27-0.30	150	2.5	2.5	2.5	3.0	3.0
141-200	0.25-0.29	125	1.5	1.5	2.0	2.0	2.0
105-140	0.22-0.28	100	1.0	1.5	1.5	1.5	1.5
Space cooling systems (chilled water, refrigerant and brine)							
			Nonres	Res	Nonres	Res	
40-60	0.21-0.27	75	0.5	0.75	0.5	0.75	1.0	1.0	1.0
Below 40	0.20-0.26	50	1.0		1.5		1.5	1.5	1.5

B. Steam and Steam Condensate, 350 Deg F (177 Deg C) and Below:

1. All Pipe Sizes: Insulation shall be the following:
   a. Cellular Glass: Submitted insulation shall meet Title-24 minimum insulation standards as noted below. Insulation shall maintain a conductivity as noted in the table. In addition, the insulation thickness shall vary per the table.

b.

FLUID TEMPERATURE RANGE (°F)	CONDUCTIVITY RANGE (in Btu-inch per hour per square foot per °F)	INSULATION MEAN RATING TEMPERATURE (°F)	NOMINAL PIPE DIAMETER (in inches)				
			<1	1 to <1.5	1.5 to <4	4 to <8	≥8
			INSULATION THICKNESS REQUIRED (in inches)				
Space heating and service water heating systems (steam, steam condensate and hot water);							
Above 350	0.32-0.34	250	4.5	5.0	5.0	5.0	5.0
251-350	0.29-0.32	200	3.0	4.0	4.5	4.5	4.5
201-250	0.27-0.30	150	2.5	2.5	2.5	3.0	3.0
141-200	0.25-0.29	125	1.5	1.5	2.0	2.0	2.0
105-140	0.22-0.28	100	1.0	1.5	1.5	1.5	1.5
Space cooling systems (chilled water, refrigerant and brine)							
			Nonres	Res	Nonres	Res	
40-60	0.21-0.27	75	0.5	0.75	0.5	0.75	1.0	1.0	1.0
Below 40	0.20-0.26	50	1.0		1.5		1.5	1.5	1.5

C. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be the following:
   a. Cellular Glass: Submitted insulation shall meet Title-24 minimum insulation standards as noted below. Insulation shall maintain a conductivity as noted in the table. In addition, the insulation thickness shall vary per the table.

b.

FLUID TEMPERATURE RANGE (°F)	CONDUCTIVITY RANGE (in Btu-inch per hour per square foot per °F)	INSULATION MEAN RATING TEMPERATURE (°F)	NOMINAL PIPE DIAMETER (in inches)				
			<1	1 to <1.5	1.5 to <4	4 to <8	≥8
			INSULATION THICKNESS REQUIRED (in inches)				
Space heating and service water heating systems (steam, steam condensate and hot water);							
Above 350	0.32-0.34	250	4.5	5.0	5.0	5.0	5.0
251-350	0.29-0.32	200	3.0	4.0	4.5	4.5	4.5
201-250	0.27-0.30	150	2.5	2.5	2.5	3.0	3.0
141-200	0.25-0.29	125	1.5	1.5	2.0	2.0	2.0
105-140	0.22-0.28	100	1.0	1.5	1.5	1.5	1.5
Space cooling systems (chilled water, refrigerant and brine)							
			Nonres	Res	Nonres	Res	
40-60	0.21-0.27	75	0.5	0.75	0.5	0.75	1.0	1.0	1.0
Below 40	0.20-0.26	50	1.0		1.5		1.5	1.5	1.5

3.15 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.
2. PVC: 20 mils (0.5 mm) thick.

3.16 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. Aluminum, Stucco Embossed with Z-Shaped Locking Seam: 0.016 inch (0.41 mm) thick.
2. Stainless Steel, Type 304 Stucco Embossed with Z-Shaped Locking Seam: 0.010 inch (0.25 mm) thick.

END OF SECTION 230719

SECTION 230800 - COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes commissioning process requirements for HVAC&R systems, assemblies, and equipment.

B. Related Sections:

1. Section 019113 "General Commissioning Requirements" for general commissioning process requirements.

1.3 DEFINITIONS

A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

B. CxA: Commissioning Authority.

C. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.

D. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.4 INFORMATIONAL SUBMITTALS

A. Certificates of readiness.

B. Certificates of completion of installation, prestart, and startup activities.

1.5 ALLOWANCES

A. Labor, instrumentation, tools, and equipment costs for technicians for the performance of commissioning testing are covered by the "Schedule of Allowances" Article in Section 012100 "Allowances."

1.6 UNIT PRICES

A. Commissioning testing allowance may be adjusted up or down by the "List of Unit Prices" Article in Section 012200 "Unit Prices" when actual man-hours are computed at the end of commissioning testing.

1.7 CONTRACTOR'S RESPONSIBILITIES

A. Perform commissioning tests at the direction of the CxA.

B. Attend construction phase controls coordination meeting.

C. Attend testing, adjusting, and balancing review and coordination meeting.

D. Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.

E. Provide information requested by the CxA for final commissioning documentation.

F. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

1.8 CxA'S RESPONSIBILITIES

A. Provide Project-specific construction checklists and commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.

B. Direct commissioning testing.

C. Verify testing, adjusting, and balancing of Work are complete.

D. Provide test data, inspection reports, and certificates in Systems Manual.

1.9 COMMISSIONING DOCUMENTATION

A. Provide the following information to the CxA for inclusion in the commissioning plan:

1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for HVAC&R systems, assemblies, equipment, and components to be verified and tested.
4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
5. Certificate of readiness certifying that HVAC&R systems, subsystems, equipment, and associated controls are ready for testing.
6. Test and inspection reports and certificates.
7. Corrective action documents.
8. Verification of testing, adjusting, and balancing reports.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

A. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.

B. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.

C. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.

D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

E. Inspect and verify the position of each device and interlock identified on checklists.

F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.2 TESTING AND BALANCING VERIFICATION

A. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.

B. Notify the CxA at least 10 days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.

C. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the CxA.

1. The CxA will notify testing and balancing Contractor 10 days in advance of the date of field verification. Notice will not include data points to be verified.
2. The testing and balancing Contractor shall use the same instruments (by model and serial number) that were used when original data were collected.
3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.
4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

3.3 GENERAL TESTING REQUIREMENTS

A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.

B. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.

C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

D. The CxA along with the HVAC&R Contractor, testing and balancing Contractor, and HVAC&R Instrumentation and Control Contractor shall prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.

E. Tests will be performed using design conditions whenever possible.

F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

G. The CxA may direct that set points be altered when simulating conditions is not practical.

H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.

I. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.

J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.4 HVAC&R SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

A. Boiler Testing and Acceptance Procedures: Testing requirements are specified in HVAC boiler Sections. Provide submittals, test data, inspector record, and boiler certification to the CxA.

B. HVAC&R Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Section 230900 "Instrumentation and Control for HVAC" and Section 230993 "Sequence and Operations for HVAC Controls." Assist the CxA with preparation of testing plans.

C. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in HVAC piping Sections. HVAC&R Contractor shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the CxA. Plan shall include the following:

1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector, showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
2. Description of equipment for flushing operations.
3. Minimum flushing water velocity.
4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.

D. Refrigeration System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of chillers, cooling towers, refrigerant compressors and condensers, heat pumps, and other refrigeration systems. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.

E. HVAC&R Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air, steam, and hydronic distribution systems; special exhaust; and other distribution systems, including HVAC&R terminal equipment and unitary equipment.

F. Vibration and Sound Tests: Provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation and seismic controls.

END OF SECTION 230800

SECTION 230900 - INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

B. Related Sections include the following:

1. Division 23 Section "Meters and Gages for HVAC Piping" for measuring equipment that relates to this Section.

1.3 DEFINITIONS

A. DDC: Direct digital control.

B. I/O: Input/output.

C. MS/TP: Master slave/token passing.

D. PC: Personal computer.

E. PID: Proportional plus integral plus derivative.

F. RTD: Resistance temperature detector.

1.4 SEQUENCE OF OPERATION

A. On plans

1.5 SUBMITTALS

A. Product Demonstration

1. Contractor submittals shall include links or digital demonstration files for control systems with similar scope and size. Submittal notes shall include specific exclusions or variations that should be expected.

B. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.

2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
2. Schematic flow diagrams showing fans, pumps, valves, and control devices.
3. Wiring Diagrams: Power, signal, and control wiring.
4. Details of control panel faces, including controls, instruments, and labeling.
5. Written description of sequence of operation.
6. Schedule of valves including flow characteristics.
7. DDC System Hardware:

    a. Wiring diagrams for control units with termination numbers.
    b. Schematic diagrams and floor plans for field sensors and control hardware.
    c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.

8. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
9. Controlled Systems:

    a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
    b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
    c. Written description of sequence of operation including schematic diagram.
    d. Points list.

D. Data Communications Protocol Certificates: All hardware and software is to be BACnet compatible.

E. Software and Firmware Operational Documentation: Include the following:

1. Software operating and upgrade manuals.
2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.
5. Software license required by and installed for DDC workstations and control systems.

F. Field quality-control test reports.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.

B. System Software: Update to latest version of software at Project completion.

1.7 COORDINATION

A. The Controls Contractor shall coordinate and review all equipment and equipment submittals that are required to integrated into the building management system. The contracting team may elect to defer the installation of controls sensors to the equipment manufacturers but it is the responsibility of the controls

contractor to verify compatibility of all components and systems that are to be integrated into the building management system.

B. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.

C. Coordinate equipment with Division 26 Section "Electrical Power Monitoring and Control" to achieve compatibility of communication interfaces.

D. Coordinate equipment with Division 26 Sections to achieve compatibility with starter coils and annunciation devices.

PART 2 - PRODUCTS

2.1 CONTROL SYSTEM

A. Manufacturers:

1. Delta Controls (Installing Contractor: Automated Controls)
2. Johnson Controls (Installing Contractor: Albireo Energy)
3. Distech Controls (Installing Contractor: Albireo Energy)
4. Alerton (Installing Contractor: Climatec)
5. Automated Logic Corporation, Inc (Installing Contractor: Integrated Energy Solutions)
6. Honeywell (Installing Contractor: R&R Controls, Inc)
7. KMC Controls (Installing Contractor: Emcor Services Integrated Solutions)
8. Honeywell (Installing Contractor: Honeywell Building Solutions, Local Branch)

2.2 SOFTWARE REQUIREMENTS

A. Navigation
1. Front page graphics shall include high resolution graphics of the entire GeneTheory mpus.
2. Front page shall include shortcuts to alarms and notifications.

B. Real time animated graphics
1. Example. Equipment fans shall be displayed/animated with rotating fans when operational. When disabled fans shall be dispayed/animated as static.

C. Accessibility
1. Internet / Smart phone compatibility
   a. Front end software shall be HTML compatible and shall be accessible by mobile devices.
2. Alerts and Alarms.
   a. Mobile device texting alerts
      1) Specific alarms and alerts that shall be coordinated with owner.

2.3 DDC EQUIPMENT

A. Operator Laptop Workstation: One PC-based microcomputer(s) with minimum configuration as follows. When requirements by the controls vendor differ the contractor shall take the greater of the requirements.

1. Motherboard: With 2 integrated USB 2.0 ports, integrated Intel Pro 10/100 (Ethernet), integrated audio, bios, and hardware monitoring.
2. Processor: Current generation of Intel or AMD processor required for front end software.
3. Random-Access Memory: 4 GB.
4. Monitor: Minimum 15 inches (480 mm), LCD color.
5. Keyboard: Standart QWERTY style.
6. SSD or 7500-RPM Hard-Disk Drive: Minimum 2x space required for system OS and all installed building controls software. Not to be less than 160GB.
7. DVD-R-ROM Read/Write Drive.

8. Separate Wired Mouse: Three button, optical.
9. Operating System: Latest generation of Microsoft Windows OS compatible with front end software with high-speed Internet access.

    a. ASHRAE 135 Compliance: Workstation shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.

10. Application Software:

    a. I/O capability from operator station.
    b. System security for each operator via software password and access levels.
    c. Automatic system diagnostics; monitor system and report failures.
    d. Database creation and support.
    e. Automatic and manual database save and restore.
    f. Dynamic color graphic displays.
    g. Custom graphics generation and graphics library of HVAC equipment and symbols.
    h. Alarm processing, messages, and reactions.
    i. Trend logs retrievable in spreadsheets and database programs.
    j. Alarm and event processing.
    k. Object and property status and control.
    l. Automatic restart of field equipment on restoration of power.
    m. Data collection, reports, and logs. Include standard reports for the following:

        1) Current values of all objects.
        2) Current alarm summary.
        3) Disabled objects.
        4) Alarm lockout objects.
        5) Logs.

    n. Custom report development.
    o. Utility and weather reports.
    p. Workstation application editors for controllers and schedules.
    q. Maintenance management.

11. Custom Application Software:

    a. English language oriented.
    b. Full-screen character editor/programming environment.
    c. Allow development of independently executing program modules with debugging/simulation capability.
    d. Support conditional statements.
    e. Support floating-point arithmetic with mathematic functions.
    f. Contains predefined time variables.

B. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.

1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.
2. Stand-alone mode control functions operate regardless of network status. Functions include the following:

    a. Global communications.
    b. Discrete/digital, analog, and pulse I/O.
    c. Monitoring, controlling, or addressing data points.
    d. Software applications, scheduling, and alarm processing.
    e. Testing and developing control algorithms without disrupting field hardware and controlled environment.

3. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
4. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol
5. Listing: BACnet testing Laboratory (BTL) listed.

C. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.

1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
2. Stand-alone mode control functions operate regardless of network status. Functions include the following:

    a. Global communications.
    b. Discrete/digital, analog, and pulse I/O.
    c. Monitoring, controlling, or addressing data points.

3. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
4. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
5. Listing: BACnet testing Laboratory (BTL) listed.

D. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.

1. Binary Inputs: Allow monitoring of on-off signals without external power.
2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation with three-position (on-off-auto) override switches and status lights.
5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA) [with status lights, two-position (auto-manual) switch, and manually adjustable potentiometer].
6. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.
7. Universal I/Os: Provide software selectable binary or analog outputs.

E. Power Supplies: Transformers serving low voltage loops shall be sized so that an additional 20% of similar devices can be added to the loop without requiring additional transformers or changing wire size.

F. Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity so that an additional 20 percent of similar devices can be added to the loop without requiring additional transformers or changing wire size. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:

1. Output ripple of 5.0 mV maximum peak to peak.
2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.

G. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:

1. Minimum dielectric strength of 1000 V.
2. Maximum response time of 10 nanoseconds.
3. Minimum transverse-mode noise attenuation of 65 dB.
4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

H. UPS: UPSs shall be installed for all devices with volatile memory that have would otherwise have to implement a reload process to restart operations after a power failure.

2.4 UNITARY CONTROLLERS

A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.

1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and [72] <Insert number>-hour battery backup.
2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform automatic system diagnostics; monitor system and report failures.
3. ASHRAE 135 Compliance: Communicate using read (execute and initiate) and write (execute and initiate) property services defined in ASHRAE 135. Reside on network using MS/TP datalink/physical layer protocol and have service communication port for connection to diagnostic terminal unit.
4. Listing: BACnet testing Laboratory.
5. Indoor Enclosures: Dustproof rated for operation at 32 to 120 deg F (0 to 50 deg C).
   Outdoor Enclosures: Waterproof rated for operation at 40 to 150 deg F (5 to 65 deg C).

2.5 ELECTRONIC SENSORS

A. RTDs and Transmitters:

1. Accuracy: Plus or minus 0.2 percent at calibration point.
2. Wire: Twisted, shielded-pair cable.
3. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches (64 mm).

B. Pressure Transmitters/Transducers:

1. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig (1034-kPa) operating pressure; linear output 4 to 20 mA.

2.6 STATUS SENSORS

A. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.

B. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.

C. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.

D. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.

E. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

F. Water-Flow Switches: Bellows-actuated mercury or snap-acting type with pilot-duty rating, stainless-steel or bronze paddle, with appropriate range and differential adjustment, in NEMA 250, Type 1 enclosure.

2.7 BALANCING AND CONTROL VALVES (Hydronic)

A. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated. Control valves shall maintain a minimum system authority of 0.25.

B. Manufacturers. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Victaulic
2. Or Equal

C. Installing contractor shall provide a shop drawing noting system sensor locations, and system differential pressure sensor locations as needed to maintain a minimum system loop authority of 0.25

D. System Differential Pressure Stabilizer:

1. Maximum differential pressure is 51 psi / 350 kPa, maximum temperature is 248°F / 120°C for use in heating and cooling systems only. NPT threaded valve body and bonnet shall be manufactured of copper alloy, O-rings, seat seal, and membrane manufactured of HBNR. Shall have adjustable differential control, single pressure temperature port, dead end service shut off capabilities, stainless steel spring, polymide handle, and drain if required by project engineer.
2. Shall be capable of stabilizing ΔpV ranges of 1.5- 8.7 psi/10-60 kPa in sizes 3/4-1"/15-25 mm or 2.9-11.6 psi/23-80 kPa in
3. Sizes 11/4- 2"/32-50 mm, as determined by project engineer or certified Victaulic/TA representative. TA Series 786- STAD,
4. TA Series 787-STAS, TA Series 788-STAG, TA Series 789-STAF dependent on system size and connection requirements.
5. Capillary tube, hose kit, and all connection fittings shall be manufactured by Tour and Andersson to ensure proper operation of installed STAP valves. Mechanical contractor and balancing contractor shall be trained on installation, connection, and balancing procedures by certified Victaulic/TA representative

E. 2-way flow control

1. 2-way Pressure Balancing and Control Valve

a. The valve shall have flow balancing, isolation and a two-port control valve in the same body.
b. The valve isolation should be achieved either by the control actuator or manually with a shutoff cap.
c. The valve internals shall have a double plug and seat for balancing and controlling flow from the regulated position.
d. The valve should be able to have a universal removable adjustment key to preset Cv values in the conventional manner. The adjustment key can be removed to prevent any tampering by unintended personnel.
e. The combined balancing and control valve for small terminal units shall require no maintenance and shall not include replaceable cartridges.
f. The valves shall be available with a modulating actuator.

g. The valve presetting and control plug can be kept fully open when flushing the piping system.

2. 2-way Pressure Independent Balancing and Control Valve

a. The valve shall have an in-built linear control valve characteristic, best suited for on-off control.
b. The valve shall have flow balancing, isolation, a two-way control valve and differential pressure regulator in the same body.

c. The valve shall have an integrated differential pressure controller to maintain full controllability at any opening of the control part regardless of pressure changes in the system up to the max Dp rating of the valve (58 psi).
d. The valve isolation for system maintenance should be achieved by the control actuator or through the in-built dial position.
e. The valve internals shall have a plug and seat for balancing and controlling flow from the regulated position.
f. The valve should be able to have an in-built manual adjustment to preset maximum flow values in the field in a conventional manner. The adjustment mechanism should be covered with the actuator during the operation to prevent tampering.
g. The valve shall have a capability of bypassing DP controller to enable measurement of available head.
h. The valve shall have a capability to measure the flow, temperature, pressure drop and available head directly through the standard pressure and temperature ports available on the front side of the valve body.
i. The pressure independent balancing and control valve for small terminal units shall have a startup pressure of no more than 2.2 psi (½"-3/4") and no more than 3.63 psi (1"- 1 ¼") .
j. The pressure independent balancing and control valve for small terminal units shall require no maintenance and shall not include replaceable cartridges.
k. The valves shall be available with a Normally Open or Normally Closed on-off actuator.
l. The valve shall have availability of different connections like female NPT and female SWT connections available via a union connection nut.

F. 3-way flow control

1. Balancing Valve. AutoFlow combination ball valve, AutoFlow regulator and union with up to five (5) accessory port locations. Unit is factory set to automatically limit the flow rate to within 5% of the specified amount. The flow cartridge is removable from the valve body to provide access for flow rate changes, inspection, and cleaning without breaking the main piping. The ball valve has PTFE packing, brass packing nut and blowout-proof stem, large diameter plated ball and a full size steel handle with vinyl grip.
2. Characterized Control Ball Valve

a. Pressure Rating: 400 psig
b. Body: Forged brass, nickel plated
c. Ball: Stainless steel
d. Stem: Nickel plated brass.
e. Seat: PTFE
f. Disc: Tefzel
g. Packing: Lubricated EPDM o-rings.
h. Ends: NPT

2.8 ACTUATORS

A. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.

1. Valves: Size for torque required for valve close off at maximum pump differential pressure.
2. Dampers: Size for running torque calculated as follows:

a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft of damper.
d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft of damper.
e. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.
f. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.

3. Coupling: V-bolt and V-shaped, toothed cradle.
4. Overload Protection: Electronic overload or digital rotation-sensing circuitry.

5. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on non-spring-return actuators.
6. Power Requirements Two-Position Spring Return: 24 V ac.
7. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
8. Temperature Rating: Minus 22 to plus 122 deg F
9. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that power supply is available to control units and operator workstation.

B. Verify that duct, pipe, and equipment-mounted devices and wiring and piping are installed before proceeding with installation.

C. Obtain the manufacturer data for the proposed HVAC equipment. Verify the electric power supply requirements of control interfaces and connections. Coordinate with electrical and mechanical contractors and other trades.

3.2 INSTALLATION

A. Install DDC Controllers for a complete and operational system. Install all DDC controllers inside NEMA rated control panels.

B. Install control wiring and electrical work in accordance with California Electrical Code and Division 26. In addition to the requirements specified herein, the wiring installation shall meet the requirements of EIA / TIA Standard 569; Commercial Building Standard for Telecommunications Pathways and Spaces.

C. Connect and configure equipment and software to achieve sequence of operation specified.

D. Wiring Inside Rigid Conduit: Outdoor exposed areas and areas exposed to weather, chiller and boiler rooms. Minimum conduit size 3/4".

E. Identification Standards:

1. Node Identification: All nodes shall be identified by a permanent label fastened to the outside of the enclosure.
2. Cable shall be labeled at a minimum of every 18” with the type of signal carried within the cable.
3. Raceway Identification: All the covers to junction and pull boxes of the control raceways shall be painted with the appropriate color.
4. Wire Identification: All low and line voltage control wiring shall be identified by a number, as referenced to the associated shop drawing and as-built drawing.
5. Control wiring color coding shall be consistent throughout this project. Coordinate with the owner and other trades. Provide communication and control wiring with proper identification and labeling. Clearly label and color code control wiring as follows:

    a. Orange: Local area network wiring.
    b. Blue: Analog and digital, input or output points.
    c. Green: Low voltage power wiring.
    d. White: Line voltage wiring, or per California Electrical Code.

F. Do not install low and line voltage wiring in the same conduit.

G. Install labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC Piping and Equipment."

H. Install hydronic instrument wells, valves, and other accessories according to Division 23 Section "Hydronic Piping."

3.3 COMMISSIONING OF BUILDING AUTOMATION SYSTEM

A. Commission Per ASHRAE Standard: Commissioning Report shall include the following:

1. Seventy-Two Hour Trend
2. Installation Verification of Building Automation System.

B. Coordinate and provide the required expertise and services for a complete commissioning process. Coordinate with all other trades for a complete commissioned system.

C. The Control Engineer shall be present on-site for all commissioning activities involving equipment and systems controlled and monitored by the DDC system.

3.4 SEVENTY-TWO HOUR TREND DATA

A. Final acceptance of the completion of the DDC shall be based upon the 72-hour Trend Data. The Trend Data shall be in form of color Trend Graph. Provide Trend Data of all temperatures, air- and water- flow quantities, and equipment status points. This shall include outside air, chilled water, heating hot water temperatures, pressures, actuator positions, states (on/off/open/closed) of all pieces of equipment and devices, and set points. The trend data shall also include variable frequency drive speed and frequency. Submit specified list of points and graphic format of trending for approval prior to commencement of 72-hour trending.

B. A factory-trained control technician with minimum of three-years experience shall be physically present at the jobsite from 8:00 am to 5:00 pm during every 72-hour trending process until final acceptance.

C. Upon completion submit the results indicating compliance in one complete package. Submit six sets.

3.5 INSTALLATION VERIFICATION OF BUILDING AUTOMATION SYSTEM

A. Controller Verification: Perform verification procedure on each main or modular controller prior to software installation and prior to commencement of point to point check-out.

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove malfunctioning units, replace with new units, and retest.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment, and retest.
3. Calibration test electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.

B. Engage a factory-authorized service representative to perform startup service.

C. Replace damaged or malfunctioning controls and equipment.

1. Start test, and adjust control systems.
2. Demonstrate compliance with requirements, including calibration and testing, and control sequences
3. Adjust calibrate, and fine tune circuits and equipment to achieve sequence of operation specified.

D. Replace damaged or malfunctioning controls and equipment.

1. Verify software including automatic restart, control sequences, scheduling, reset controls, and occupied/unoccupied cycles.
2. Verify local control units including self-diagnostics.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 230900

SECTION 231123 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipes, tubes, and fittings.
2. Piping and tubing joining materials.
3. Valves.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

1.4 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig (690 kPa) minimum unless otherwise indicated.

B. Natural-Gas System Pressure: More than 2 psig (13.8 kPa) but not more than 5 psig (34.5 kPa).

1.5 SUBMITTALS

A. Product Data: For each type of the following:

1. Piping specialties.
2. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.
B. 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.

C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.
D. Protect stored PE pipes and valves from direct sunlight.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.

    a. Material Group: 1.1.
    b. End Connections: Threaded.
    c. Lapped Face: Not permitted underground.
    d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
    e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.

3. Mechanical Couplings:

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Dresser Piping Specialties; Division of Dresser, Inc.
        2) Smith-Blair, Inc.

    b. Steel flanges and tube with epoxy finish.
    c. Buna-nitrile seals.
    d. Steel bolts, washers, and nuts.
    e. Coupling shall be capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
    f. Steel body couplings installed underground on plastic pipe shall be factory equipped with anode.

B. PE Pipe: ASTM D 2513, SDR 11.

1. PE Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.
2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D 2513, SDR 11; and steel pipe complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
3. Anodeless Service-Line Risers: Factory fabricated and leak tested.

    a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet.
    b. Aboveground Portion: PE transition fitting.
    c. Tracer wire connection.

4. Transition Service-Line Risers: Factory fabricated and leak tested.

    a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet connected to steel pipe complying with ASTM A 53/A 53M, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.
    b. Outlet shall be threaded or flanged or suitable for welded connection.
    c. Bridging sleeve over mechanical coupling.
    d. Factory-connected anode.

e. Tracer wire connection.
f. Ultraviolet shield.
g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

5. Plastic Mechanical Couplings, NPS 1-1/2 (DN 40) and Smaller: Capable of joining PE pipe to PE pipe.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Lyall, R. W. & Company, Inc.
2) Mueller Co.; Gas Products Div.
3) Perfection Corporation; a subsidiary of American Meter Company.

b. PE body with molded-in, stainless-steel support ring.
c. Buna-nitrile seals.
d. Acetal collets.
e. Electro-zinc-plated steel stiffener.

2.2 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.
B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.3 MANUAL GAS SHUTOFF VALVES

A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2 (DN 50) and Smaller: Comply with ASME B16.33.

1. CWP Rating: 125 psig (862 kPa)
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch (25 mm) and smaller.
6. Service Mark: Valves 1-1/4 inches (32 mm) to NPS 2 (DN 50) shall have initials "WOG" permanently marked on valve body.

C. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. McDonald, A. Y. Mfg. Co.
b. Mueller Co.; Gas Products Div.
c. Xomox Corporation; a Crane company.

2. Body: Cast iron, complying with ASTM A 126, Class B.
3. Plug: Bronze or nickel-plated cast iron.
4. Seat: Coated with thermoplastic.
5. Stem Seal: Compatible with natural gas.
6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.

7. Operator: Square head or lug type with tamperproof feature where indicated.
8. Pressure Class: 125 psig (862 kPa).
9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

D. PE Ball Valves: Comply with ASME B16.40.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Kerotest Manufacturing Corp.
b. Lyall, R. W. & Company, Inc.
c. Perfection Corporation; a subsidiary of American Meter Company.

2. Body: PE.

3. Ball: PE.
4. Stem: Acetal.

5. Seats and Seals: Nitrile.
6. Ends: Plain or fusible to match piping.
7. CWP Rating: 80 psig (552 kPa).
8. Operating Temperature: Minus 20 to plus 140 deg F (Minus 29 to plus 60 deg C).
9. Operator: Nut or flat head for key operation.
10. Include plastic valve extension.
11. Include tamperproof locking feature for valves where indicated on Drawings.

2.4 LABELING AND IDENTIFYING

A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored yellow.

PART 3 - EXECUTION

3.1 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

B. Inspect natural-gas piping according to NFPA 54 to determine that natural-gas utilization devices are turned off in piping section affected.
C. Comply with NFPA 54 requirements for prevention of accidental ignition.

3.2 OUTDOOR PIPING INSTALLATION

A. Comply with NFPA 54 for installation and purging of natural-gas piping.
B. Install underground, natural-gas piping buried at least 30 inches below finished grade. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

1. If natural-gas piping is installed less than 30 inches below finished grade, install it in containment conduit.

C. Install underground, PE, natural-gas piping according to ASTM D 2774.

D. Steel Piping with Protective Coating:

1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
3. Replace pipe having damaged PE coating with new pipe.

E. Install fittings for changes in direction and branch connections.

3.3 VALVE INSTALLATION

A. Install underground valves with valve boxes.
B. Install anode for metallic valves in underground PE piping.

3.4 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.
B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean using sharp dies.
3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
5. 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.

D. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.5 CONNECTIONS

A. Connect to utility's gas main according to utility's procedures and requirements.

3.6 LABELING AND IDENTIFYING

A. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for piping and valve identification.
B. Install detectable warning tape directly above gas piping, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.7 PAINTING

A. Comply with requirements in Division 09 painting Sections for painting interior and exterior natural-gas piping.
B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.

1. Alkyd System: MPI EXT 5.1D.

a. Prime Coat: Alkyd anticorrosive metal primer.
b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
c. Topcoat: Exterior alkyd enamel semigloss.
d. Color: Gray

C. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.
B. Tests and Inspections:

1. Test, inspect, and purge natural gas according to NFPA 54 and authorities having jurisdiction.

C. Natural-gas piping will be considered defective if it does not pass tests and inspections.
D. Prepare test and inspection reports.

3.9 OUTDOOR PIPING SCHEDULE

A. Underground natural-gas piping shall be the following:

1. PE pipe and fittings joined by heat fusion, or mechanical couplings; service-line risers with tracer wire terminated in an accessible location.

B. Aboveground natural-gas piping shall be the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

3.10 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Valves for pipe sizes NPS 2 (DN 50) and smaller at service meter shall be the following:

1. Cast-Iron, Nonlubricated Plug Valve.

B. Distribution piping valves for pipe sizes NPS 2 (DN 50) and smaller shall be the following:

1. Cast-Iron, Nonlubricated Plug Valve.

END OF SECTION 231123

SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes pipe and fitting materials and joining methods for the following:

1. Hot-water heating piping.
2. Makeup-water piping.
3. Air-vent piping.
4. Safety-valve-inlet and -outlet piping.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following:
1. Chemical treatment.

B. Delegated-Design Submittal:

1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
2. Locations of pipe anchors and alignment guides and expansion joints and loops.
3. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.
4. Locations of and details for penetration and firestopping for fire- and smoke-rated wall and floor and ceiling assemblies.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Piping layout, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
2. Other building services.
3. Structural members.

B. Qualification Data: For Installer.

C. Welding certificates.

D. Field quality-control reports.

E. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:

1. Hot-Water Heating Piping: 150 psig (kPa) at 200 deg F (93 deg C).
2. Makeup-Water Piping: 80 psig (552 kPa) at 150 deg F (66 deg C).
3. Air-Vent Piping: 200 deg F (93 deg C).
4. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L (ASTM B 88M, Type B)

B. Wrought-Copper Unions: ASME B16.22.

2.3 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.

B. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

C. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Butt welding.
3. Facings: Raised face.

2.4 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum thickness unless otherwise 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.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

D. 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.

E. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.5 TRANSITION FITTINGS

A. Plastic-to-Metal Transition Fittings:

1. One-piece fitting with one threaded brass or copper insert and one solvent-cement-joint end of material and wall thickness to match plastic pipe material.

B. Plastic-to-Metal Transition Unions:

1. Brass or copper end, solvent-cement-joint end of material and wall thickness to match plastic pipe material, rubber gasket, and threaded union.

2.6 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Description:

a. Standard: ASSE 1079.
b. Pressure Rating: 150 psig (1035 kPa).
c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Description:

a. Standard: ASSE 1079.
b. Factory-fabricated, bolted, companion-flange assembly.
c. Pressure Rating: 150 psig (1035 kPa) minimum at 180 deg F (82 deg C).
d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Description:

a. Nonconducting materials for field assembly of companion flanges.
b. Pressure Rating: 150 psig (1035 kPa).
c. Gasket: Neoprene or phenolic.
d. Bolt Sleeves: Phenolic or polyethylene.
e. Washers: Phenolic with steel backing washers.

2.7 BYPASS CHEMICAL FEEDER

A. Description: Welded steel construction; 125-psig (860-kPa) working pressure; 5-gal. (19-L) capacity; with fill funnel and inlet, outlet, and drain valves.

1. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Hot-water heating piping, aboveground, NPS 2 (DN 50) and smaller, shall be the following:

1. Type L (Type B), drawn-temper copper tubing, wrought-copper fittings, and brazed joints.

B. Hot-water heating piping, aboveground, NPS 2-1/2 (DN 65) and larger, shall be the following:
1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

C. Makeup-water piping installed aboveground shall be the following:

1. Type L (Type B), drawn-temper copper tubing, wrought-copper fittings, and brazed joints.

D. Air-Vent Piping:

1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.
2. Outlet: Type K (Type A), annealed-temper copper tubing with soldered or flared joints.

E. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.

3.2 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping 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. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 (DN 20) ball valve, and short NPS 3/4 (DN 20) threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

P. Install valves according to Section 230523 "General-Duty Valves for HVAC Piping."

Q. Install unions in piping, NPS 2 (DN 50) and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 (DN 65) and larger, at final connections of equipment and elsewhere as indicated.

S. Install shutoff valve immediately upstream of each dielectric fitting.

T. Comply with requirements in Section 230516 "Expansion Fittings and Loops for HVAC Piping" for installation of expansion loops, expansion joints, anchors, and pipe alignment guides.

U. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.

V. 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."

W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.3 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric unions.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flanges.

3.4 HANGERS AND SUPPORTS

A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.

B. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment" for seismic restraints.

C. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet (6 m) long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 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. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4 (DN 20): Maximum span, 7 feet (2.1 m).
2. NPS 1 (DN 25): Maximum span, 7 feet (2.1 m).
3. NPS 1-1/2 (DN 40): Maximum span, 9 feet (2.7 m).
4. NPS 2 (DN 50): Maximum span, 10 feet (3 m).
5. NPS 2-1/2 (DN 65): Maximum span, 11 feet (3.4 m).
6. NPS 3 (DN 80) and Larger: Maximum span, 12 feet (3.7 m).

E. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4 (DN 20): Maximum span, 5 feet (1.5 m); minimum rod size, 1/4 inch (6.4 mm).
2. NPS 1 (DN 25): Maximum span, 6 feet (1.8 m); minimum rod size, 1/4 inch (6.4 mm).
3. NPS 1-1/4 (DN 32): Maximum span, 7 feet (2.1 m); minimum rod size, 3/8 inch (10 mm).
4. NPS 1-1/2 (DN 40): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
5. NPS 2 (DN 50): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
6. NPS 2-1/2 (DN 65): Maximum span, 9 feet (2.7 m); minimum rod size, 3/8 inch (10 mm).
7. NPS 3 (DN 80) and Larger: Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (10 mm).

F. Support vertical runs at roof, at each floor, and at 10-foot (3-m) intervals between floors.

3.5 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. 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/A5.8M.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.6 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

D. Install ports for pressure gages and thermometers at coil inlet and outlet connections. Comply with requirements in Section 230519 "Meters and Gages for HVAC Piping."

3.7 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION 232113

SECTION 232123 - HYDRONIC PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Close-coupled, in-line centrifugal pumps.
2. Close-coupled, end-suction centrifugal pumps.

1.3 DEFINITIONS

A. Buna-N: Nitrile rubber.

B. EPT: Ethylene propylene terpolymer.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of pump. Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.

B. Shop Drawings: For each pump.

1. Show pump layout and connections.
2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
3. Include diagrams for power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. ITT Corporation; Bell & Gossett.

2. Armstrong Pumps Inc.
3. Aurora Pump; Division of Pentair Pump Group.
4. TACO Incorporated.

B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically.

C. Pump Construction:

1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, replaceable bronze wear rings, and threaded, companion-flange connections.
2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
3. Pump Shaft: Stainless steel.
4. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and EPT bellows and gasket. Include water slinger on shaft between motor and seal.
5. Seal: Packing seal consisting of stuffing box with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.
6. Pump Bearings: Permanently lubricated ball bearings.

D. Motor: Single speed and rigidly mounted to pump casing.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

a. Enclosure: Totally enclosed, fan cooled.
b. Enclosure Materials: Cast aluminum.
c. Motor Bearings: Permanently lubricated ball bearings.

d. Efficiency: Premium efficient.
e. Service Factor: 1.15

E. Capacities and Characteristics: Refer to mechanical schedules and plans for capacities and characteristics.

2.2 CLOSE-COUPLED, END-SUCTION CENTRIFUGAL PUMPS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. ITT Corporation; Bell & Gossett.
2. Armstrong Pumps Inc.
3. Aurora Pump; Division of Pentair Pump Group.
4. TACO Incorporated.

B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally.

C. Pump Construction:

1. Casing: Radially split, cast iron, with replaceable bronze wear rings, drain plug at bottom and air vent at top of volute, threaded gage tappings at inlet and outlet, and threaded companion-flange or flanged connections.

2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
3. Pump Shaft: Stainless steel.
4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and EPT bellows and gasket. Include water slinger on shaft between motor and seal.
5. Pump Bearings: Permanently lubricated ball bearings

D. Motor: Single speed and rigidly mounted to pump casing with integral pump support.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

a. Enclosure: Totally enclosed, fan cooled
b. Enclosure Materials: Cast aluminum.
c. Motor Bearings: Permanently lubricated ball bearings.

d. Efficiency: Premium efficient.
e. Service Factor: 1.15

E. Capacities and Characteristics: Refer to mechanical schedules and plans for capacities and characteristics.

2.3 PUMP SPECIALTY FITTINGS

A. Suction Diffuser:

1. Angle pattern.
2. 175-psig (1204-kPa) pressure rating, cast-iron body and end cap, pump-inlet fitting.
3. Bronze startup and bronze or stainless-steel permanent strainers.
4. Bronze or stainless-steel straightening vanes.
5. Drain plug.
6. Factory-fabricated support.

B. Triple-Duty Valve:

1. Angle or straight pattern.
2. 175-psig (1204-kPa) pressure rating, cast-iron body, pump-discharge fitting.
3. Drain plug and bronze-fitted shutoff, balancing, and check valve features.
4. Brass gage ports with integral check valve and orifice for flow measurement.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.

C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

D. Automatic Condensate Pump Units: Install units for collecting condensate and extend to open drain.

E. Equipment Mounting: Install base-mounted pumps on cast-in-place concrete equipment bases. Comply with requirements for equipment bases specified in Section 033000 "Cast-in-Place Concrete."

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct bases to withstand, without damage to equipment, seismic force required by code.
3. Construct concrete bases 4 inches (100 mm) high and extend base not less than 6 inches (150 mm) in all directions beyond the maximum dimensions of base-mounted pumps unless otherwise indicated or unless required for seismic-anchor support.

3.3 ALIGNMENT

A. Engage a factory-authorized service representative to perform alignment service.

B. Comply with requirements in Hydronics Institute standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.

C. Comply with pump and coupling manufacturers' written instructions.

D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.4 CONNECTIONS

A. Comply with requirements for piping specified in Section 232213 "Steam and Condensate Heating Piping" and Section 232216 Steam and Condensate Piping Specialties." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to pump, allow space for service and maintenance.

C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

E. Install triple-duty valve on discharge side of pumps.

F. Install Y-type strainer or suction diffuser and shutoff valve on suction side of pumps.

G. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.

H. Install pressure gages on pump suction and discharge or at integral pressure-gage tapping, or install single gage with multiple-input selector valve.

I. Install check valve and gate or ball valve on each condensate pump unit discharge.

J. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

K. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Perform the following startup checks for each pump before starting:

    a. Verify bearing lubrication.
    b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
    c. Verify that pump is rotating in the correct direction.

5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
6. Start motor.
7. Open discharge valve slowly.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.

END OF SECTION 232123

SECTION 232300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes refrigerant piping used for air-conditioning applications.

1.3 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-410A: Per manufacturer IOM and recommended test pressures.

1.4 ACTION SUBMITTALS

A. Shop Drawings: 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. Show interface and spatial relationships between piping and equipment.

1. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual 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.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to 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."

1.8 PRODUCT STORAGE AND HANDLING

A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

1.9 COORDINATION

A. Coordinate size and location of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 077200 "Roof Accessories."

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 88, Type K or L (ASTM B 88M, Type A or B).

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Brazing Filler Metals: AWS A5.8.

2.2 REFRIGERANTS

A. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-410A

A. Copper, Type L (B), drawn-temper tubing and wrought-copper fittings with brazed joints.

B. Safety-Relief-Valve Discharge Piping: Copper, Type L (B), annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

A. Accessories, valves, and specialty components shall be installed per equipment manufacturer requirements and recommendations.

3.3 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 230900 "Instrumentation and Control for HVAC" and Section 230993 "Sequence of Operations for HVAC Controls" 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. Install refrigerant piping in protective conduit where installed belowground.

N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

O. 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.

P. 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.

Q. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

R. Identify refrigerant piping and valves according to Section 230553 "Identification for HVAC Piping and Equipment."

S. 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."

T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.4 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.

3.5 HANGERS AND SUPPORTS

A. Hanger, support, and anchor products are 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 sizes:

1. NPS 1/2 (DN 15): Maximum span, 60 inches (1500 mm); minimum rod size, 1/4 inch (6.4 mm).
2. NPS 5/8 (DN 18): Maximum span, 60 inches (1500 mm); minimum rod size, 1/4 inch (6.4 mm).
3. NPS 1 (DN 25): Maximum span, 72 inches (1800 mm); minimum rod size, 1/4 inch (6.4 mm).
4. NPS 1-1/4 (DN 32): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
5. NPS 1-1/2 (DN 40): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
6. NPS 2 (DN 50): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
7. NPS 2-1/2 (DN 65): Maximum span, 108 inches (2700 mm); minimum rod size, 3/8 inch (9.5 mm).
8. NPS 3 (DN 80): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (9.5 mm).
9. NPS 4 (DN 100): Maximum span, 12 feet (3.7 m); minimum rod size, 1/2 inch (13 mm).

D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 2 (DN 50): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (9.5 mm).
2. NPS 2-1/2 (DN 65): Maximum span, 11 feet (3.4 m); minimum rod size, 3/8 inch (9.5 mm).
3. NPS 3 (DN 80): Maximum span, 12 feet (3.7 m); minimum rod size, 3/8 inch (9.5 mm).
4. NPS 4 (DN 100): Maximum span, 14 feet (4.3 m); minimum rod size, 1/2 inch (13 mm).

E. Support multifloor vertical runs at least at each floor.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. 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 Part 1 "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.

3.7 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.

3.8 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. Open shutoff valves in condenser water circuit.
2. Verify that compressor oil level is correct.
3. Open compressor suction and discharge valves.
4. Open refrigerant valves except bypass valves that are used for other purposes.
5. 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 232300

SECTION 232500 - HVAC WATER TREATMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following HVAC water-treatment systems:

1. Bypass chemical-feed equipment and controls.
2. Chemical treatment test equipment.
3. HVAC water-treatment chemicals.

1.3 DEFINITIONS

A. EEPROM: Electrically erasable, programmable read-only memory.

B. 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.

C. RO: Reverse osmosis.

D. TDS: Total dissolved solids.

E. UV: Ultraviolet.

1.4 PERFORMANCE REQUIREMENTS

A. Water quality for HVAC systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without creating a hazard to operating personnel or the environment.

B. Base HVAC water treatment on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.

C. Closed hydronic systems, including hot-water heating, shall have the following water qualities:

1. pH: Maintain a value within 9.0 to 10.5.
2. "P" Alkalinity: Maintain a value within 100 to 500 ppm.
3. Boron: Maintain a value within 100 to 200 ppm.
4. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm.
5. Soluble Copper: Maintain a maximum value of 0.20 ppm.
6. TDS: Maintain a maximum value of 10 ppm.
7. Ammonia: Maintain a maximum value of 20 ppm.
8. Free Caustic Alkalinity: Maintain a maximum value of 20 ppm.
9. Microbiological Limits:

a. Total Aerobic Plate Count: Maintain a maximum value of 1000 organisms/ml.

b. Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/ml.
c. Nitrate Reducers: Maintain a maximum value of 100 organisms/ml.

1.5 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for the following products:

1. Bypass feeders.
2. Chemical test equipment.
3. Chemical material safety data sheets.

1.6 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports.

B. Other Informational Submittals:

1. Water-Treatment Program: Written sequence of operation on an annual basis for the application equipment required to achieve water quality defined in the "Performance Requirements" Article above.
2. Water Analysis: Illustrate water quality available at Project site.
3. Passivation Confirmation Report: Verify passivation of galvanized-steel surfaces, and confirm this observation in a letter to Architect.

1.7 QUALITY ASSURANCE

A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.

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.

1.8 MAINTENANCE SERVICE

A. Scope of Maintenance Service: Provide chemicals and service program to maintain water conditions required above to inhibit corrosion, scale formation, and biological growth for heating, hot-water piping and steam and condensate system for humidifier applications and equipment. Services and chemicals shall be provided for a period of one year from date of Substantial Completion, and shall include the following:

1. Initial water analysis and HVAC water-treatment recommendations.
2. Startup assistance for Contractor to flush the systems, clean with detergents, and initially fill systems with required chemical treatment prior to operation.
3. Periodic field service and consultation.
4. Customer report charts and log sheets.
5. Laboratory technical analysis.
6. Analyses and reports of all chemical items concerning safety and compliance with government regulations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Griswold

2.2 MANUAL CHEMICAL-FEED EQUIPMENT

A. Bypass Feeders: Steel, with corrosion-resistant exterior coating, minimum 3-1/2-inch (89-mm) fill opening in the top, and NPS 3/4 (DN 20) bottom inlet and top side outlet. Quarter turn or threaded fill cap with gasket seal and diaphragm to lock the top on the feeder when exposed to system pressure in the vessel.

1. Capacity: 5 gal. (19 L).
2. Minimum Working Pressure: 125 psig (860 kPa).

2.3 CHEMICAL TREATMENT TEST EQUIPMENT

A. Test Kit: Manufacturer-recommended equipment and chemicals in a wall-mounting cabinet for testing pH, TDS, inhibitor, chloride, alkalinity, and hardness; sulfite and testable polymer tests for high-pressure boilers, and oxidizing biocide test for open cooling systems.

2.4 CHEMICALS

A. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment, and that can attain water quality specified in Part 1 "Performance Requirements" Article.

PART 3 - EXECUTION

3.1 WATER ANALYSIS

A. Perform an analysis of supply water to determine quality of water available at Project site.

3.2 INSTALLATION

A. Install chemical application equipment on concrete bases, level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor chemical tanks and floor-mounting accessories to substrate.

B. Install water testing equipment on wall near water chemical application equipment.

C. Bypass Feeders: Install in closed hydronic systems, including hot-water heating, and equipped with the following:

1. Install bypass feeder in a bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
2. Install water meter in makeup water supply.

3. Install test-coupon assembly in bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
4. Install a gate or full-port ball isolation valves on inlet, outlet, and drain below feeder inlet.
5. Install a swing check on inlet after the isolation valve.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Make piping connections between HVAC water-treatment equipment and dissimilar-metal piping with dielectric fittings. Dielectric fittings are specified in Section 232113 "Hydronic Piping."

D. Install shutoff valves on HVAC water-treatment equipment inlet and outlet. Metal general-duty valves are specified in Section 230523 "General-Duty Valves for HVAC Piping."

E. Refer to Section 221119 "Domestic Water Piping Specialties" for backflow preventers required in makeup water connections to potable-water systems.

F. Confirm applicable electrical requirements in electrical Sections for connecting electrical equipment.

G. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

H. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 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. Report results in writing.

B. Perform tests and inspections and prepare test reports.

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. Inspect field-assembled components and equipment installation, including piping and electrical connections.
2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of HVAC systems' startup procedures.
4. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
5. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
6. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.

7. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
8. Repair leaks and defects with new materials and retest piping until no leaks exist.

D. Remove and replace malfunctioning units and retest as specified above.

E. Sample boiler water at one-week intervals after boiler startup for a period of five weeks, and prepare test report advising Owner of changes necessary to adhere to Part 1 "Performance Requirements" Article for each required characteristic. Sample boiler water at four-week intervals following the testing noted above to show that automatic chemical-feed systems are maintaining water quality within performance requirements specified in this Section.

F. At four-week intervals following Substantial Completion, perform separate water analyses on hydronic systems to show that automatic chemical-feed systems are maintaining water quality within performance requirements specified in this Section. Submit written reports of water analysis advising Owner of changes necessary to adhere to Part 1 "Performance Requirements" Article.

G. Comply with ASTM D 3370 and with the following standards:

1. Silica: ASTM D 859.
2. Steam System: ASTM D 1066.
3. Acidity and Alkalinity: ASTM D 1067.
4. Iron: ASTM D 1068.
5. Water Hardness: ASTM D 1126.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment. Refer to Section 017900 "Demonstration and Training."

B. Training: Provide a "how-to-use" self-contained breathing apparatus video that details exact operating procedures of equipment.

END OF SECTION 232500

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Double-wall rectangular ducts and fittings.
3. Single-wall round ducts and fittings.
4. Double-wall round ducts and fittings.
5. Commercial Kitchen Ducts
6. Sheet metal materials.
7. Duct liner.
8. Sealants and gaskets.
9. Hangers and supports.
10. Seismic-restraint devices.

1.3 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, 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. 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.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated and intended usage/location.

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. Penetrations through fire-rated and other partitions.

8. Equipment installation based on equipment being used on Project.
9. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: 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. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:

a. Lighting fixtures.
b. Air outlets and inlets.
c. Speakers.
d. Sprinklers.
e. Access panels.
f. Perimeter moldings.

B. Welding certificates.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 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."

2.2 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. McGill AirFlow LLC.
2. Sheet Metal Connectors, Inc.
3. Or equal.

B. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct.

C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

D. 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."

E. 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."

F. Interstitial Insulation: Mineral fiber liner with a minimum insulation value of R-8.

G. Inner Duct: Minimum 0.028-inch (0.7-mm) perforated galvanized sheet steel having 3/32-inch- (2.4-mm-) diameter perforations, with overall open area of 23 percent

H. Formed-on Transverse Joints (Flanges): Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Traverse 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."

I. 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."

2.3 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."

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."

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."

2.4 DOUBLE-WALL ROUND DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Lindab Inc.
2. McGill AirFlow LLC.
3. SEMCO Incorporated.
4. Sheet Metal Connectors, Inc.
5. Or equal.

B. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.

1. 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."

2. 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."

3. 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."

C. Inner Duct: Minimum 0.028-inch (0.7-mm) perforated galvanized sheet steel having 3/32-inch- (2.4-mm-) diameter perforations, with overall open area of 23 percent

D. Interstitial Insulation: Mineral fiber liner with a minimum insulation value of R-8.

2.5 COMMERCIAL KITCHEN DUCTS

A. Ducts shall be constructed of and supported by 304 stainless steel not less than 0.060 of an inch (1.524 mm) (No. 16 MSG) in thickness.

B. Duct-to-Duct connections shall be in accordance with Section 510.5.3.2, “Welded Duct Connection” of the California Mechanical Code – 2016.

C. Commercial Kitchens exhaust ducts shall terminate in accordance with Section 510.9 for Type-I (grease) or Section 510.10 for Type-II (steam) of the California Mechanical Code – 2016.

D. Ducts shall have a clearance of not less than 18” (457 mm) to combustible material, 3 inches (76 mm) to limited-combustible material, and 0” (0 mm) to noncombustible material.

E. Field-applied grease duct enclosures shall be protected with a through penetration firestop system classified in accordance with ASTM E814 or UL1479 having an “F” and “T” rating equal to the fire resistance rating assembly being penetrated. The field-applied grease duct shall be listed in accordance with ASTM E2336.

2.6 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 (Z275).
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. PVC-Coated, Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90 (Z275).
2. Minimum Thickness for Factory-Applied PVC Coating: 4 mils (0.10 mm) thick on sheet metal surface of ducts and fittings exposed to corrosive conditions, and minimum 1 mil (0.025 mm) thick on opposite surface.
3. Coating Materials: Acceptable to authorities having jurisdiction for use on ducts listed and labeled by an NRTL for compliance with UL 181, Class 1.

D. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

E. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

F. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.7 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
2. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

    a. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
    b. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Natural-Fiber Duct Liner: 85 percent cotton, 10 percent borate, and 5 percent polybinding fibers, treated with a microbial growth inhibitor and complying 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 according to ASTM E 84; certified by an NRTL.
2. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

    a. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
    b. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

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-) 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- (0.41-mm) thick galvanized steel; 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 (12.7 m/s).
7. Secure liner with mechanical fasteners 4 inches (100 mm) from corners and at intervals not exceeding 12 inches (300 mm) transversely; at 3 inches (75 mm) from transverse joints and at intervals not exceeding 18 inches (450 mm) 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 (12.7 m/s) or where indicated.

9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.

    a. Sheet Metal Inner Duct Perforations: 3/32-inch (2.4-mm) diameter, with an overall open area of 23 percent.

10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.8 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 3 inches (76 mm)
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.

6. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
11. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg (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.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg (0.14 L/s per sq. m at 250 Pa) and shall be rated for10-inch wg (2500-Pa) 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.

2.9 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. 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."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. 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.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. 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.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.10 SEISMIC-RESTRAINT DEVICES

A. 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.

B. Restraint Cables: ASTM A 603, galvanized or ASTM A 492, stainless-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.

C. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or Reinforcing steel angle clamped to hanger rod.

PART 3 - EXECUTION

3.1 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. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. 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 (38 mm).

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.

3.2 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 the 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.

3.3 ADDITIONAL INSTALLATION REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT

A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease, and sloped a minimum of 2 percent to drain grease back to the hood.

B. Install fire-rated access panel assemblies at each change in direction and at maximum intervals of 12 feet (3.7 m) in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings. Locate access panel on top or sides of duct a minimum of 1-1/2 inches (38 mm) from bottom of duct.

C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.4 DUCTS LOCATED OUTDOORS

A. Slope the top of rectangular ducts 1/4" per linear foot to prevent water accumulation.

3.5 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 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. Supply-Air Ducts (all conditions): Seal Class A.
3. Outdoor, Exhaust/Return-Air Ducts: Seal Class C.
4. Exhaust/Return-Air ducts located in unconditioned or conditioned space: Seal Class B.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: refer to structural plans for attachment requirements.

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 (610 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. 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).

F. 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.

3.7 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.

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.

3.8 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.

3.9 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.

B. Paint exterior of metal ducts exposed to outdoor environment. Paint shall be rated for outdoor use and provide the duct with protection from the coastal conditions.

C. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.10 START UP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

A. Supply Ducts:

1. Ducts Connected downstream of supply air valves, VAV terminals units and Fan coils:

a. Pressure Class: Positive 1-inch wg (250 Pa)
b. SMACNA Leakage Class for Rectangular: 12
c. SMACNA Leakage Class for Round: 12

2. Ducts Connected to Air-Handling Units

a. Pressure Class: Positive 4-inch wg – upstream of supply air valves and VAV terminals

b. Type: G90, galvanized sheet steel
c. SMACNA Leakage Class for Rectangular: 6
d. SMACNA Leakage Class for Round: 12

B. Return Ducts:

1. Ducts Connected to Air-Handling Units

a. Pressure Class: Positive or negative 1-inch wg (250 Pa)
b. SMACNA Leakage Class for Rectangular: 12
c. SMACNA Leakage Class for Round: 12

C. Exhaust Ducts:

1. Ducts Connected to Laboratory Air Fans (exhaust ducts connected to fume hoods, BSCs and ventilated enclosures only)

a. Pressure Class: Negative 4-inch wg between fans and exhaust air valves
b. Pressure Class: Negative 1-inch wg between air valves and hoods/encolsures
c. PVC coated galvanized steel
d. Minimum SMACNA Seal Class: A
e. SMACNA Leakage class: 3

2. Ducts Connected to Laboratory air fans (Steam Hoods)

a. Pressure Class: Negative 1-inch wg, between exhaust air valves and steam hood
b. Type 304, Stainless-steel sheet
   1) Concealed: No. 2D
   2) Exposed: No. 2B
c. Welded seams and flanged joints with watertight EPDM gaskets
d. Pressure class: Negative 3-inch wg
e. SMACNA Leakage Class: 3

3. Ducts connected to Laboratory air fans (exhaust ducts connected to ceiling grilles):

a. Pressure class: Negative 4-inch wg, between fans and exhaust air valves
b. Pressure class: Negative 1-inch wg between exhaust air valves and grilles
c. Type: G90, galvanized steel
d. SMACNA leakage class: 6

4. Ducts Connected to Commercial Kitchen Hoods: Comply with NFPA 96.

a. Exposed to View: Type 304, stainless-steel sheet, No. 4
b. Concealed: Carbon-steel sheet
c. Welded seams and joints.
d. Pressure Class: Negative 2-inch wg (500 Pa)

e. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
f. SMACNA Leakage Class: 3.

D. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel
2. PVC-Coated Ducts:

a. Exposed to Airstream: Match duct material.
b. Not Exposed to Airstream: Galvanized

3. Stainless-Steel Ducts:

a. Exposed to Airstream: Match duct material.
b. Not Exposed to Airstream: Match duct material.

E. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

F. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

2. Round Duct: 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 233113

SECTION 233116 - NONMETAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Underground Ducts

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following products:
1. Underground Ducts
2. Sealants and Gaskets

B. Shop Drawings: for underground ducts, include plans, elevations, sections, details, and attachments to other work.

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Duct layout indicating sizes and pressure classes.
3. Elevation of top of ducts.
4. Dimensions of main duct runs from building grid lines.
5. Fittings.
6. Penetrations through fire-rated and other partitions.
7. Burial and supports, including methods for duct burial and internal and external bracing if recommended by the manufacturer.

1.4 INFORMATIONAL SUBMITTALS

A. Installation and Maintenance Data: include installation and maintenance manuals
1. Instructions for joining ducts
2. Instructions for proper backfilling and precautions.

1.5 QUALITY ASSURANCE

A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 UNDERGROUND DUCTS

A. Manufacturers: Subject to compliance with requirements provide products by one of the following:
   1. BlueDuct by AQC Industries
   2. Or equal

B. Underground duct systems

   1. Complete duct system (including: plenums, round duct, run-outs, diffuser boots, etc.) must be from one manufacturer and be of the same material, construction and connection method throughout. Field made duct components are not acceptable.
   2. Include the complete underground duct system including plenums and diffuser boots.
   3. Unless otherwise noted, all duct and fittings shall be constructed per SMACNA's Duct Construction Standards.
   4. Provide elbows, duct, diffuser, plenums, clamp and gasket, boots, saddle registers, caulk, water gauge test and adapters as required by drawings for underground installation.
   5. Ductwork shall be HDPE, closed cell plastic material that is recyclable, does not emit volatile organic compounds, and conforms to ASTM-D2412. Ductwork shall be resistant to mildew, mold (UL 181B), and radon gas (BSS 7239-88). Ductwork shall not rust or crack under external stress or strain. Ductwork shall have R-10 equivalent thermal performance value without the use of external insulation.
   6. All joints shall be sealed via gasket or bolts with sealant. Clamps and gaskets shall be used on ductwork without flanges. Clamps shall be polyethylene with 410 stainless steel plates and stainless steel screws. Gaskets shall comprise of 1/4" thick butyl rubber sealant tape with siler polyester facing that is water and UV resistant and shall not stain. Gaskets shall comply with ASTM-E84 for flame and smoke spread.
   7. Flanged joints and duct branches shall use a co-polymer adhesive caulking sealant that is water and UV resistant. Flanges shall be connected with stainless steel bolts.
   8. Assembled ductwork shall be able to maintain +/- 10" static pressure with no leakage.
   9. Assembled ductwork shall be approved for installations 48" below flood plain elevation without water intrusion.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Install ducts with fewest possible joints.

B. Install ducts based on the manufacturer's installation manual.

C. Complete installation training if provided by manufacturer.

D. Backfill material shall consist of pea gravel or sand.

3.2 FIELD QUALITY CONTROL

A. Perform tests and inspections for leakage after final assembly.

B. Follow SMACNA's air duct leakage test standard.

C. Allow 24 hours for the sealant to cure after final assembly before testing the duct system. Additional curing time may be required in high ambient conditions.

3.3 DUCT CLEANING

A. Remove dust and debris from ductwork prior to occupancy.

END OF SECTION 233116

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Manual volume dampers.
3. Control dampers.
4. Combination fire and smoke dampers.
5. Duct silencers.
6. Turning vanes.
7. Remote damper operators.
8. Duct-mounted access doors.
9. Flexible connectors.
10. Flexible ducts.
11. Duct accessory hardware.

B. Related Requirements:

1. Section 233723 "HVAC Gravity Ventilators" for roof-mounted ventilator caps.
2. Section 283111 "Digital, Addressable Fire-Alarm System" for duct-mounted fire and smoke detectors.
3. Section 283112 "Zoned (DC-Loop) Fire-Alarm System" for duct-mounted fire and smoke detectors.

1.3 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.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Special fittings.
b. Manual volume damper installations.
c. Control-damper installations.
d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
e. Duct security bars.
f. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

B. Source quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 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.

2.2 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90 (Z275).
2. Exposed-Surface Finish: Mill phosphatized.

B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304,

C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

D. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.3 BACKDRAFT DAMPERS

A. Description: Gravity balanced.

B. Frame: Hat-shaped, 0.05-inch- (1.3-mm-) thick, galvanized sheet steel, with welded corners or mechanically attached and mounting flange.

C. Blades: Multiple single-piece blades, center pivoted, maximum 6-inch (150-mm) width, with sealed edges.

D. Blade Action: Parallel.

E. Blade Seals: Neoprene, mechanically locked.

F. Blade Axles:

1. Material: Galvanized steel.

G. Tie Bars and Brackets: Galvanized steel.

H. Return Spring: Adjustable tension.

I. Bearings: synthetic pivot bushings.

J. 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. Screen Mounting: Rear mounted.
7. 90-degree stops.

2.4 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, 0.05-inch- (1.3-mm-) thick stainless 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 (if required) Stainless-steel, 0.064 inch (1.62 mm) thick.

5. Blade Axles: Galvanized (if required) Stainless-steel.
6. Bearings:

    a. Stainless-steel sleeve.
    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.

2.5 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Ruskin Company.

B. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.

C. Closing rating in ducts up to 4-inch wg (1-kPa) static pressure class and minimum 2000-fpm (10-m/s) velocity.

D. Fire Rating: 1-1/2 hours.

E. Frame: Hat-shaped, 0.094-inch- (2.4-mm-) thick, galvanized sheet steel, with welded corners and mounting flange.

F. Heat-Responsive Device: Electric resettable link and switch package, factory installed, rated.

G. Smoke Detector: Integral, factory wired for single-point connection.

H. Blades: Roll-formed, horizontal, interlocking, 0.063-inch- (1.6-mm-) thick, galvanized sheet steel.

I. Leakage: Class II

J. Rated pressure and velocity to exceed design airflow conditions.

K. Damper Motors: two-position action.

L. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 230900 "Instrumentation and Control for HVAC."
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F (minus 40 deg C).
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft. (2.3 sq. m), size motor for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 300 in. x lbf (34 N x m).
7. Electrical Connection: 115 V, single phase, 60 Hz.

2.6 FLANGE CONNECTORS

A. Description: Add-on, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

B. Material: Galvanized steel.

C. Gage and Shape: Match connecting ductwork.

2.7 DUCT SILENCERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. IAC.

2. Vibro-Acoustics.

B. General Requirements:

1. Factory fabricated.
2. Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84.
3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Shape:

1. Rectangular straight with splitters or baffles.
2. Round straight with center bodies or pods.
3. Rectangular elbow with splitters or baffles.
4. Round elbow with center bodies or pods.
5. Rectangular transitional with splitters or baffles.

D. Rectangular Silencer Outer Casing: ASTM A 653/A 653M, G90 (Z275) galvanized sheet steel, 0.034 inch (0.85 mm) thick.

E. Inner Casing and Baffles: ASTM A 653/A 653M, G90 (Z275) galvanized sheet metal, 0.034 inch (0.85 mm) thick, and with 1/8-inch- (3-mm-) diameter perforations.

F. Connection Sizes: Match connecting ductwork unless otherwise indicated.

G. Principal Sound-Absorbing Mechanism:

1. Controlled impedance membranes and broadly tuned resonators without absorptive media.

H. Source Quality Control: Test according to ASTM E 477.

I. Capacities and Characteristics:

1. Refer to mechanical plans and schedules for capacities and characteristics.

2.8 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. 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."

C. Vane Construction: Single wall for ducts up to 48 inches (1200 mm) wide and double wall for larger dimensions.

2.9 REMOTE DAMPER OPERATORS

A. Description: Cable system designed for remote manual damper adjustment.

B. Cable: Steel.

2.10 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 (300 mm) Square: No hinges and two sash locks.
   b. Access Doors up to 24 by 48 Inches (600 by 1200 mm): Three hinges and two compression latches.
   c. Access Doors Larger Than 24 by 48 Inches (600 by 1200 mm): Four hinges and two compression latches with outside and inside handles.

2.11 FLEXIBLE CONNECTORS

A. Materials: Flame-retardant or noncombustible fabrics.

B. Coatings and Adhesives: Comply with UL 181, Class 1.

C. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp and 360 lbf/inch (63 N/mm) in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).

D. 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. (810 g/sq. m).
2. Tensile Strength: 530 lbf/inch (93 N/mm) in the warp and 440 lbf/inch (77 N/mm) in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F (Minus 45 to plus 121 deg C).

2.12 FLEXIBLE DUCTS

A. Insulated, Flexible Duct: UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.

1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
2. Maximum Air Velocity: 4000 fpm (20 m/s).
3. Temperature Range: Minus 20 to plus 210 deg F (Minus 29 to plus 99 deg C).
4. Insulation R-value: Comply with T24

2.13 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

3.1 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. 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.

1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.

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. Install fire and smoke dampers according to UL listing.

H. Connect ducts to duct silencers rigidly.

I. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.
2. Upstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
7. At each change in direction and at maximum 50-foot (15-m) spacing.
8. Upstream from turning vanes.
9. Upstream or downstream from duct silencers.
10. Control devices requiring inspection.
11. Elsewhere as indicated.

J. Install access doors with swing against duct static pressure.

K. 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).

L. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

M. Install flexible connectors to connect ducts to equipment.

N. For fans developing static pressures of 5-inch wg (1250 Pa) and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

O. Connect terminal units to supply ducts directly.

P. Connect diffusers or light troffer boots to ducts with maximum 60-inch (1500-mm) lengths of flexible duct clamped or strapped in place.

Q. Connect flexible ducts to metal ducts with draw bands or adhesive plus sheet metal screws.

R. Install duct test holes where required for testing and balancing purposes.

S. 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.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

SECTION 233423 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Utility set fans.
2. Centrifugal roof ventilators.
3. In-line centrifugal fans.

1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on **actual Project site elevations**.

B. Operating Limits: Classify according to AMCA 99.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness and finishes, including color charts.
5. Dampers, including housings, linkages, and operators.
6. Roof curbs.
7. Fan speed controllers.

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. Delegated-Design Submittal: For unit hangars and 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. 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.
2. Design Calculations: Calculate requirements for selecting vibration isolators **and seismic restraints** and for designing vibration isolation bases.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Roof framing and support members relative to duct penetrations.
2. Ceiling suspension assembly members.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.7 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. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

C. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

1.8 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate sizes and locations of concrete bases with actual equipment provided.

C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 UTILITY SET FANS

A. Manufacturers: Subject to compliance with requirements, **available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**:

1. Greenheck.
2. Loren Cook Company.

B. Housing: Fabricated of **galvanized** steel with side sheets fastened with a deep lock seam or welded to scroll sheets.

1. Housing Discharge Arrangement: Adjustable to eight standard positions.

C. Fan Wheels: Single-width, single inlet; welded to cast-iron or cast-steel hub and spun-steel inlet cone, with hub keyed to shaft.

1. Blade Materials: **Steel**.
2. Spark-Resistant Construction (where required): AMCA 99, Type **A**.

D. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.

E. Shaft Bearings: Prelubricated and sealed, self-aligning, pillow-block-type ball bearings with ABMA 9, **L_{50} of 200,000 hours**.

1. Extend grease fitting to accessible location outside of unit.

F. Belt Drives:

1. Factory mounted, with final alignment and belt adjustment made after installation
2. Service Factor Based on Fan Motor Size: **1.5 (Smoke Fans), 1.2 (all others)**.
3. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
4. Belt Guards: Fabricate of steel for motors mounted on outside of fan cabinet.

G. Accessories:

1. Inlet and Outlet: Flanged.
2. Companion Flanges: Rolled flanges for duct connections of same material as housing.
3. Backdraft Dampers: Gravity actuated with counterweight and interlocking aluminum blades with felt edges in steel frame installed on fan discharge.
4. Access Door: Gasketed door in scroll with latch-type handles.
5. Scroll Dampers: Single-blade damper installed at fan scroll top with adjustable linkage.
6. Inlet Screens: Removable wire mesh.
7. Drain Connections: NPS 3/4 (DN 20) threaded coupling drain connection installed at lowest point of housing.
8. Weather Hoods: Weather resistant with stamped vents over motor and drive compartment.
9. Discharge Dampers: Assembly with **opposed** blades constructed of two plates formed around and to shaft, channel frame, sealed ball bearings, with blades linked outside of airstream to single control lever of same material as housing.
10. Variable Inlet Vanes: With blades supported at both ends with two permanently lubricated bearings of same material as housing. Variable mechanism terminating in single control lever with control shaft for double-width fans.
11. Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
12. Kitchen Grease Exhaust fans shall be provided with **grease collector**.

H. Capacities and Characteristics:

1. Refer to mechanical plans and schedules for capacities and characteristics.

2.2 CENTRIFUGAL ROOF VENTILATORS

A. Manufacturers: Subject to compliance with requirements, **available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**:

1. Greenheck.
2. Loren Cook Company.

B. Housing: Removable, **galvanized steel, mushroom-domed top**; square, one-piece, aluminum base with venturi inlet cone.

1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains. Kitchen Grease Exhaust fans shall be provided with **grease collector**.
2. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.

C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

D. Belt Drives:

1. Resiliently mounted to housing.
2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
4. Pulleys: Cast-iron, adjustable-pitch motor pulley.
5. Fan and motor isolated from exhaust airstream.

E. Accessories:
1. Bird Screens: Removable, 1/2-inch (13-mm) mesh, aluminum or brass wire.
2. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
3. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.

F. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- (40-mm-) thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch (40-mm) wood nailer. Size as required to suit roof opening and fan base.

G. Capacities and Characteristics:

1. Refer to mechanical plans and schedules for capacities and characteristics.

2.3 IN-LINE CENTRIFUGAL FANS

A. Manufacturers: Subject to compliance with requirements, **available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**:

1. Greenheck.
2. Loren Cook Company.

B. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

C. Direct-Drive Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.

D. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.

E. Accessories:
1. Companion Flanges: For inlet and outlet duct connections.
2. Fan Guards: 1/2- by 1-inch (13- by 25-mm) mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
3. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

F. Capacities and Characteristics:

1. Refer to mechanical plans and schedules for capacities and characteristics.

2.4 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

B. Enclosure Type: Totally enclosed, fan cooled.

2.5 SOURCE QUALITY CONTROL

A. Certify sound-power level ratings according to 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. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install power ventilators level and plumb.

B. Support hanging units using **elastomeric mounts**. Vibration- and seismic-control devices are specified in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."

1. Secure vibration and seismic controls to concrete bases using anchor bolts cast in concrete base.

C. Install floor-mounted units on concrete bases. Concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete."

D. Secure roof-mounted fans to roof curbs with cadmium-plated hardware. See Section 077200 "Roof Accessories" for installation of roof curbs.

E. Install units with clearances for service and maintenance.

F. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.2 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 power ventilators to allow service and maintenance.

C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

END OF SECTION 233423

SECTION 233533 - LISTED KITCHEN VENTILATION SYSTEM EXHAUST DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Listed grease ducts.
2. Access doors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For listed grease ducts.

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. Detail fabrication and assembly of hangers and seismic restraints.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D9.1/D9.1M, "Sheet Metal Welding Code," for shop and field welding of joints and seams in listed grease ducts and field-fabricated grease ducts.

PART 2 - PRODUCTS

2.1 LISTED GREASE DUCTS

A. Manufacturers:

1. Heat-Fab, Inc.
2. McGill Airflow.
3. Metal Fab, Inc.
4. Or Equal.

B. Description: Factory-fabricated, -listed, and -labeled, double-wall ducts tested according to UL 1978 and rated for 500 deg F (260 deg C) continuously, or 2000 deg F (1093 deg C) for 30 minutes; with positive or negative duct pressure and complying with NFPA 211.

C. Construction: Inner shell and outer jacket separated by at least a 1-inch (25-mm) annular space filled with high-temperature, ceramic-fiber insulation.

1. Inner Shell: ASTM A 666, Type 316 stainless steel.

2. Outer Jacket: Stainless steel where concealed. Stainless steel where exposed.

D. Gaskets and Flanges: Ensure that gaskets and sealing materials are rated at 1500 deg F (816 deg C) minimum.

E. Hood Connectors: Constructed from same material as grease duct with internal or external continuously welded or brazed joints.

F. Accessories: Tees, elbows, increasers, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly. Include unique components required to comply with NFPA 96 including cleanouts, transitions, adapters, and drain fittings.

G. Grease Duct Supports: Construct duct bracing and supports from non-combustible material.

1. Design bracing and supports to carry static and seismic loads within stress limitations of the International Building Code.
2. Ensure that bolts, screws, rivets and other mechanical fasteners do not penetrate duct walls.

H. Comply with ASTM E 2336.

I. Factory Tests: Test and inspect fire resistance of grease duct system according to ASTM E 2336.

1. Allow consultant two days' minimum notification before test is performed.

2.2 ACCESS DOORS

A. Manufacturers:

1. 3M.
2. Acudor Products.
3. Ductmate Industries.
4. Or Equal.

B. Description: Factory-fabricated, -listed, and -labeled, double-wall maintenance access doors tested according to UL 1978 and rated for 500 deg F (260 deg C) continuously, or 2000 deg F (1093 deg C) for 30 minutes; with positive or negative duct pressure and complying with NFPA 211.

1. Construction: 0.0625 inch ((1.6 mm)) ASTM A 666, Type 316 stainless-steel inner shell and stainless-steel outer cover with two handles.
2. Fasteners: Stainless-steel bolts and wing nuts.

a. Ensure that bolts do not penetrate interior of duct space.

3. Maintenance Access Door Dimensions: 7 x 7 inches (178 x 178 mm).
4. Door Label: Mark door with uppercase lettering as follows: "ACCESS PANEL. DO NOT OBSTRUCT."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordinate connections to kitchen exhaust hoods.

B. Coordinate connections to exhaust fans with requirements in Section 233423 "HVAC Power Ventilators."

C. Coordinate firestopping where grease ducts penetrate fire separations with requirements in Section 078413 "Penetration Firestopping."

D. Comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211 and UL 2221, whichever is most stringent.

E. Install airtight maintenance access doors where indicated.

F. Seal between sections of grease exhaust ducts according to manufacturer's written installation instructions, using sealants recommended by manufacturer.

G. Connections: Make grease duct connections according to the International Mechanical Code.

1. Grease duct to exhaust fan connections: Connect grease ducts to inlet side of fan using flanges, gaskets, and bolts.
2. Grease duct to hood connections:

a. Make grease duct to hood joints connections using internal or external continuously welded or brazed joints.

H. Support ducts at intervals recommended by manufacturer to support weight of ducts and accessories, without applying loading on kitchen hoods.

1. Securely attach supports and bracing to structure.

I. Grease Duct Enclosures: Comply with requirements of the International Building Code and ASTM E 2336.

J. Provide 2-hour rated fire-wrap on ACC grease duct from kitchen hood to exhaust fan connection. Refer to drawings.

K. Repair damage to adjacent materials caused by listed kitchen ventilation system exhaust ducts installation.

3.2 FIELD QUALITY CONTROL

A. Perform air leakage test before concealment of any portion of the grease duct system.

1. Notify Owner a minimum of two days before test is performed.

END OF SECTION 23 35 33

SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Diffusers and Grilles.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, 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.

C. Source quality-control reports.

PART 2 - PRODUCTS

2.1 DIFFUSERS AND GRILLES

A. Products: See equipment schedules on plans for product description and application

1. Manufacturers: available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Titus
b. Price Industries.
c. Krueger

2.2 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as 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, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

SECTION 234133 - HIGH-EFFICIENCY PARTICULATE FILTRATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. HEPA filter fan modules.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include dimensions; operating characteristics; required clearances and access; rated flow capacity, including initial and final pressure drop at rated airflow; efficiency and test method; fire classification; furnished specialties; and accessories for each model indicated.

B. Shop Drawings: For air filters. Include plans, elevations, sections, details, and attachments to other work.

   1. Show filter rack assembly, dimensions, materials, and methods of assembly of components.
   2. Include setting drawings, templates, and requirements for installing anchor bolts and anchorages.
   3. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of filter and rack to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

   1. Provide one complete set(s) of filters for each filter bank.

1.7 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 use.

B. ASHRAE Compliance:

1. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Comply with IEST-RP-CC001.3.

D. Comply with UL 586.

E. Comply with IEST-RP-CC007.1.

F. Comply with NFPA 90A and NFPA 90B.

1.8 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

PART 2 - PRODUCTS

2.1 HEPA FILTER FAN MODULES

A. Description: Factory-fabricated, HEPA filter ceiling module with fan.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. AAF International.

B. Casing:

1. Configuration: Ducted inlet.
2. Module Material: Extruded aluminum, 16 gage with mill finish.
3. Suspension: Ceiling grid.

C. Media: Fibrous glass, constructed of continuous sheets with closely spaced pleats

D. Accessories: Filter test port.

E. Control: Variable speed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Position each filter unit with clearance for normal service and maintenance. Anchor filter holding frames to substrate.

B. Install filters in position to prevent passage of unfiltered air.

C. Install filter gage for each filter bank.

D. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters that were used during construction and testing with new, clean filters.

E. Install filter-gage static-pressure tips upstream and downstream from filters. Install filter gages on filter banks with separate static-pressure taps upstream and downstream from filters. Mount filter gages on outside of filter housing or filter plenum in an accessible position. Adjust and level inclined gages.

F. Coordinate filter installations with duct and air-handling unit installations.

3.2 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installation, 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. Operate automatic roll filters to demonstrate compliance with requirements.
2. Test for leakage of unfiltered air while system is operating.
3. HEPA Filters: Pressurize housing to a minimum of 3.0-inch wg (750 Pa) or to designed operating pressure, whichever is higher; test housing joints, door seals, and sealing edges of filter with soapy water to check for air leaks.
4. HEPA Filters: Pressurize housing to a minimum of 3.0-inch wg (750 Pa) or to designed operating pressure, whichever is higher; and test housing joints, door seals, and sealing edges of filter for air leaks according to pressure-decay method in ASME N510.

D. Air filter will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.3 CLEANING

A. After completing system installation and testing, adjusting, and balancing air-handling and air-distribution systems, clean filter housings and install new filter media.

END OF SECTION 234133

SECTION 235100 - BREECHINGS, CHIMNEYS, AND STACKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Listed single and double-wall.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Type B and BW vents.
   2. Special gas vents.

B. Shop Drawings: For vents, breechings, chimneys, and stacks. Include plans, elevations, sections, details, and attachments to other work.

   1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, methods of field assembly, components, hangers and seismic restraints, and location and size of each field connection.
   2. For installed products indicated to comply with design loads, include calculations required for selecting seismic restraints and structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Manufacturer Seismic Qualification Certification: Submit certification that factory-fabricated breeching, chimneys, and stacks; accessories; and components will withstand seismic forces defined in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment." Include the following:

   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

      a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
      b. 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. Dimensioned Outline Drawings of Breeching, Chimneys, and Stacks: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of anchorage devices on which the certification is based and their installation requirements.

C. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain listed system components through one source from a single manufacturer.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code--Steel," for hangers and supports and AWS D9.1/D9.1M, "Sheet Metal Welding Code," for shop and field welding of joints and seams in vents, breechings, and stacks.

C. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 077200 "Roof Accessories."

PART 2 - PRODUCTS

2.1 LISTED TYPE B AND BW VENTS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Heat-Fab, Inc.

C. Description: Double-wall metal vents tested according to UL 441 and rated for 480 deg F (248 deg C) continuously for Type B, or 550 deg F (288 deg C) continuously for Type BW; with neutral or negative flue pressure complying with NFPA 211.

D. Construction: Inner shell and outer jacket separated by at least a 1/4-inch (6-mm) airspace.

E. Outer Jacket: Aluminized steel.

F. Accessories: Tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly.
1. Termination: Round chimney top designed to exclude minimum 98 percent of rainfall.

2.2 GUYING AND BRACING MATERIALS

A. Cable: Four stainless steel, stranded wires of the following thickness:

1. Minimum Size: 1/4 inch (6 mm) in diameter.
2. For ID Sizes 4 to 15 Inches (100 to 381 mm): 5/16 inch (8 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATION

A. Listed Chimney Liners: High-efficiency boiler or furnace vents in masonry chimney, dishwasher exhaust, or Type II commercial kitchen hood.

B. Listed Type B and BW Vents: Vents for certified gas appliances.

C. Listed Type L Vent: Vents for low-heat appliances.

D. Listed Special Gas Vent: Condensing gas appliances.

E. Listed Building-Heating-Appliance Chimneys: Dual-fuel boilers, oven vents, water heaters, and exhaust for engines. Fireplaces and other solid-fuel-burning appliances.

F. Listed Grease Ducts: Type I commercial kitchen grease duct.

G. Listed, Refractory-Lined Metal Breechings and Chimneys: Freestanding dual-fuel boiler vents, oven vents, water heaters, exhaust for engines, fireplaces, and other solid-fuel-burning appliances.

H. Field-Fabricated Metal Breechings and Chimneys: Dual-fuel boilers, oven vents, water heaters, exhaust for engines, fireplaces, and other solid-fuel-burning appliances.

I. Field-Fabricated Metal Breechings and Chimneys: Steel pipe for use with engine exhaust.

3.3 INSTALLATION OF LISTED VENTS AND CHIMNEYS

A. Locate to comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211, whichever is most stringent.

B. Seal between sections of positive-pressure vents and grease exhaust ducts according to manufacturer's written installation instructions, using sealants recommended by manufacturer.

C. Support vents at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading.

D. Slope breechings down in direction of appliance, with condensate drain connection at lowest point piped to nearest drain.

E. Lap joints in direction of flow.

F. Connect base section to foundation using anchor lugs of size and number recommended by manufacturer.

G. Join sections with acid-resistant joint cement to provide continuous joint and smooth interior finish.

H. Erect stacks plumb to finished tolerance of no more than 1 inch (25 mm) out of plumb from top to bottom.

3.4 INSTALLATION OF UNLISTED, FIELD-FABRICATED BREECHINGS AND CHIMNEYS

A. Suspend breechings and chimneys independent of their appliance connections.

B. Install, support, and restrain according to seismic requirements.

C. Align breechings at connections, with smooth internal surface and a maximum 1/8-inch (3-mm) misalignment tolerance.

D. Slope breechings down in direction of appliance, with condensate drain connection at lowest point piped to nearest drain.

E. Lap joints in direction of flow.

F. Support breechings and chimneys from building structure with bolts, concrete inserts, steel expansion anchors, welded studs, C-clamps, or beam clamps according to manufacturer's written instructions.

3.5 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

B. Clean breechings internally, during and after installation, to remove dust and debris. Clean external surfaces to remove welding slag and mill film. Grind welds smooth and apply touchup finish to match factory or shop finish.

C. Provide temporary closures at ends of breechings, chimneys, and stacks that are not completed or connected to equipment.

END OF SECTION 235100

SECTION 235216 - CONDENSING BOILERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes packaged, factory-fabricated and -assembled, gas-fired, outdoor condensing boilers, trim, and accessories for generating heating hot water.

1.3 ACTION SUBMITTALS

A. Product Data: Include performance data, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: For boilers, boiler trim, and accessories. Include plans, elevations, sections, details, and attachments to other work.

1. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Source quality-control reports.

B. Field quality-control reports.

C. Warranty: Special warranty specified in this Section.

D. Other Informational Submittals:

1. ASME Stamp Certification and Report: Submit "A," "S," or "PP" stamp certificate of authorization, as required by authorities having jurisdiction, and document hydrostatic testing of piping external to boiler.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For boilers to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code.

C. ASHRAE/IESNA 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."

D. DOE Compliance: Minimum efficiency shall comply with 10 CFR 430, Subpart B, Appendix N, "Uniform Test Method for Measuring the Energy Consumption of Furnaces and Boilers."

E. UL Compliance: Test boilers for compliance with UL 795, "Commercial-Industrial Gas Heating Equipment." Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of boilers that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Condensing Boilers:

a. Leakage and Materials: 5 years from date of Substantial Completion.
b. Heat Exchanger Damaged by Thermal Stress and Corrosion: 25 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONDENSING BOILERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Raypak.

B. Description: Factory-fabricated, -assembled, and -tested, water-tube condensing boiler with heat exchanger sealed pressure tight, built on a steel base; including insulated jacket; flue-gas vent; combustion-air intake connections; water supply, return, and condensate drain connections; and controls. Water heating service only.

C. Heat Exchanger: Finned-copper primary and stainless-steel secondary heat exchangers.

D. Combustion Chamber: Stainless steel, sealed.

E. Burner: Natural gas, forced draft drawing from gas premixing valve.

F. Blower: Centrifugal fan to operate during each burner firing sequence and to prepurge and postpurge the combustion chamber.

1. Motors: Comply with requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

a. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

G. Gas Train: Combination gas valve with manual shutoff and pressure regulator.

H. Ignition: Silicone carbide hot-surface ignition that includes flame safety supervision and 100 percent main-valve shutoff.

I. Integral Circulator: Cast-iron body and stainless-steel impeller sized for minimum flow required in heat exchanger.

J. Casing:

1. Jacket: Sheet metal, with snap-in or interlocking closures.
2. Control Compartment Enclosures: NEMA 250, Type 1A.
3. Finish: Textured epoxy.
4. Insulation: Minimum 1-inch- (25-mm-) thick, mineral-fiber insulation surrounding the heat exchanger.
5. Combustion-Air Connections: Inlet and vent duct collars.
6. Mounting base to secure boiler.

    a. Seismic Fabrication Requirements: Fabricate mounting base and attachment to boiler pressure vessel, accessories, and components with reinforcement strong enough to withstand seismic forces defined in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment" when mounting base is anchored to building structure.

K. Characteristics and Capacities: Refer to mechanical plans and schedules for characteristics and capacities.

2.2 TRIM

A. Include devices sized to comply with ANSI B31.9, "Building Services Piping."

B. Aquastat Controllers: Operating, firing rate, and high limit.

C. Safety Relief Valve: ASME rated.

D. Pressure and Temperature Gage: Minimum 3-1/2-inch- (89-mm-) diameter, combination water-pressure and -temperature gage. Gages shall have operating-pressure and -temperature ranges so normal operating range is about 50 percent of full range.

E. Boiler Air Vent: Automatic.

F. Drain Valve: Minimum NPS 3/4 (DN 20) hose-end gate valve.

G. Circulation Pump: Non-overloading, in-line pump with split-capacitor motor having thermal-overload protection and lubricated bearings; designed to operate at specified boiler pressures and temperatures.

2.3 TRIM

A. Include devices sized to comply with ANSI B31.9, "Building Services Piping."

B. Pressure Controllers: Operating, firing rate, and high limit.

C. Safety Relief Valve:

1. Size and Capacity: As required for equipment according to ASME Boiler and Pressure Vessel Code.
2. Description: Fully enclosed steel spring with adjustable pressure range and positive shutoff; factory set and sealed.

a. Drip-Pan Elbow: Cast iron and having threaded inlet and outlet with threads complying with ASME B1.20.1.

D. Pressure Gage: Minimum 3-1/2-inch (89-mm) diameter. Gage shall have normal operating pressure about 50 percent of full range.

E. Water Column: Minimum 12-inch (300-mm) glass gage with shutoff cocks.

F. Drain Valves: Minimum NPS 3/4 (DN 20) or nozzle size with hose-end connection.

G. Blowdown Valves: Factory-installed bottom and surface, slow-acting blowdown valves same size as boiler nozzle. Blowdown valves shall be combination of slow and quick acting as required by ANSI B31.1.

H. Stop Valves: Boiler inlets and outlets, except safety relief valves or preheater inlet and outlet, shall be equipped with stop valve in an accessible location as near as practical to boiler nozzle and same size or larger than nozzle. Valves larger than NPS 2 (DN 50) shall have rising stem.

I. Stop-Check Valves: Factory-installed, stop-check valve and stop valve at boiler outlet with free-blow drain valve factory installed between the two valves and visible when operating stop-check valve.

2.4 CONTROLS

A. Refer to Section 230900 "Instrumentation and Control for HVAC."

B. Boiler operating controls shall include the following devices and features:

1. Control transformer.
2. Set-Point Adjust: Set points shall be adjustable.
3. Operating Pressure Control: Factory wired and mounted to cycle burner.
4. Low-Water Cutoff and Pump Control: Cycle feedwater pump(s) for makeup water control.
5. Sequence of Operation: Electric, factory-fabricated and field-installed panel to control burner firing rate to maintain space temperature in response to thermostat with heat anticipator located in heated space.

C. Burner Operating Controls: To maintain safe operating conditions, burner safety controls limit burner operation.

1. High Cutoff: Automatic reset stops burner if operating conditions rise above maximum boiler design temperature or pressure.
2. Low-Water Cutoff Switch: Electronic probe shall prevent burner operation on low water. Cutoff switch shall be automatic-reset type.
3. Blocked Inlet Safety Switch: Manual-reset pressure switch field mounted on boiler combustion-air inlet.
4. Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for above conditions.

D. Building Automation System Interface: Factory install hardware and software to enable building automation system to monitor, control, and display boiler status and alarms.

1. Hardwired Points:

a. Monitoring: On/off status, common trouble alarm.
b. Control: On/off operation, hot water supply temperature set-point adjustment.

2. A communication interface with building automation system shall enable building automation system operator to remotely control and monitor the boiler from an operator workstation. Control features available, and monitoring points displayed, locally at boiler control panel shall be available through building automation system.

2.5 ELECTRICAL POWER

A. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in electrical Sections.

B. Single-Point Field Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.

2.6 VENTING KITS

A. Kit: Complete system, ASTM A 959, Type 29-4C stainless steel, pipe, vent terminal, thimble, indoor plate, vent adapter, condensate trap and dilution tank, and sealant.

B. Combustion-Air Intake: Complete system, stainless steel, pipe, vent terminal with screen, inlet air coupling, and sealant.

2.7 SOURCE QUALITY CONTROL

A. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test.

B. Test and inspect factory-assembled boilers, before shipping, according to ASME Boiler and Pressure Vessel Code.

C. Allow Owner access to source quality-control testing of boilers. Notify Architect 14 days in advance of testing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before boiler installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting boiler performance, maintenance, and operations.

1. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

B. Examine mechanical spaces for suitable conditions where boilers will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 BOILER INSTALLATION

A. Equipment Mounting: Install boilers on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases specified in Section 033000 "Cast-in-Place Concrete."

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct bases to withstand, without damage to equipment, seismic force required by code.

3. Construct concrete bases 4 inches (100 mm high and extend base not less than 6 inches (150 mm) in all directions beyond the maximum dimensions of boiler unless otherwise indicated or unless required for seismic anchor support.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete floor.
6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
7. Install anchor bolts to elevations required for proper attachment to supported equipment.

B. Install gas-fired boilers according to NFPA 54.

C. Assemble and install boiler trim.

D. Install electrical devices furnished with boiler but not specified to be factory mounted.

E. Install control wiring to field-mounted electrical devices.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to boiler to allow service and maintenance.

C. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.

D. Connect piping to boilers, except safety relief valve connections, with flexible connectors of materials suitable for service. Flexible connectors and their installation are specified in Section 232116 Hydronic Piping Specialties."

E. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of gas train connection. Provide a reducer if required.

F. Connect hot-water piping to supply- and return-boiler tappings with shutoff valve and union or flange at each connection.

G. Connect steam and condensate piping to supply-, return-, and blowdown-boiler tappings with shutoff valve and union or flange at each connection.

H. Install piping from safety relief valves to nearest floor drain.

I. Install piping from safety valves to drip-pan elbow and to nearest floor drain.

J. Boiler Venting:

1. Install flue venting kit and combustion-air intake.
2. Connect full size to boiler connections.

K. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

L. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 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 with the assistance of a factory-authorized service representative:

1. Perform installation and startup checks according to manufacturer's written instructions.
2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

    a. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level and water temperature.
    b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

F. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

G. Performance Tests:

1. Engage a factory-authorized service representative to inspect component assemblies and equipment installations, including connections, and to conduct performance testing.
2. Boilers shall comply with performance requirements indicated, as determined by field performance tests. Adjust, modify, or replace equipment to comply.
3. Perform field performance tests to determine capacity and efficiency of boilers.

    a. Test for full capacity.

4. Repeat tests until results comply with requirements indicated.
5. Provide analysis equipment required to determine performance.
6. Provide temporary equipment and system modifications necessary to dissipate the heat produced during tests if building systems are not adequate.
7. Notify Architect in advance of test dates.
8. Document test results in a report and submit to Architect.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain boilers. Refer to Section 017900 "Demonstration and Training."

END OF SECTION 235216

SECTION 236313 – VARIABLE REFRIGERANT FLOW OUTDOOR UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Variable Refrigerant Flow (VRF) HVAC system shall be a variable capacity, direct expansion (DX) heat recovery engineered system. The outdoor unit shall consist of one or more frames) connected through common refrigerant piping and control communication wiring. Each system shall have single or multiple, inverter compressor(s). Each system shall be connected to multiple indoor units (ducted, non-ducted or mixed combinations) through a common refrigerant piping network and integrated system controls and communication network. Each indoor unit shall be controlled individually or as a group. Additionally, heat recovery systems shall be capable of simultaneous heating and cooling of individual zones.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For air-cooled refrigerant condensers. 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.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.4 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. ASBSAE/IESNA 90.1 Compliance: Applicable requirements in ASBSAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. **Basis of Design** shall be Daikin. Acceptable standards shall be supplied based upon the performance characteristics and features of the DAIKIN model number(s) specified, DAIKIN model families specified and as otherwise specified here. Alternate suppliers shall request permission to bid, in writing, from the engineer at least 10 days prior to the bid date. This request by the contractor to bid an alternate supplier to the basis of design, listed or not listed, shall not relieve the contractor of supplying all materials, options, controls, sequences, efficiencies and intents of the original specifications written or implied by DAIKIN model number or model family or as otherwise specified. The written request and engineers' written response to such request shall be included in all submittal documents for approval.

B. **Alternate Equipment Bid Instruction:** The contractor shall provide basis of design bid as specified and with specified products. If the contractor should wish to propose any alternate products to the basis of designed products they shall provide a separate and complete Bid detailing the proposed alternate products and the associated adjustment of price to support the change from basis of design products. The contractor bids the alternate product with full knowledge that the proposed product may not be acceptable or approved. In no event shall the contractor be entitled to additional compensation to supply such specified products, options or sequences. Any and all additional cost, to any party, because of any product submitted on or supplied other than that of the original specified products shall be the responsibility of the contractor without recourse.

C. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:

1. DAIKIN Electronics

2. LG
3. Or Equivalent

2.2 VRF OUTDOOR UNITS (HEAT RECOVERY) UNITS

A. Heat recovery system shall be an air cooled, system consisting of one to three outdoor unit modules, conjoined to make a single refrigerant circuit, connected to Heat Recovery (BSU) unit(s) and indoor unit(s). Multi-port branch selector units shall allow simultaneous heating and cooling of individual zone(s) at various capacities as required to satisfy their zone requirements. Simultaneous heating and cooling shall be supported. The heat recovery system shall consist of three pipes, liquid, suction and hot gas pipes, two pipe heat recovery systems that cannot deliver, at zero degrees outdoor ambient, 162F hot gas to the indoor coils for heat shall not be acceptable.

B. Refrigerant: R-410A

C. Compressor(s).

1. Each inverter driven, HSS scroll compressor shall be capable of operating from 15 Hz up to 150 Hz with control in 0.5 Hz increments in any and all modes (cooling OR heating)
2. Manufacturers that employ speed limiting algorithms designed to limit compressor capacity to lower power amperage draw shall not be permitted.
3. The compressor shall employ a factory metered charge of oil.
4. The compressor shall be designed for a separate port for oil to be directly returned to the compressor oil sump.
5. The compressor bearing(s) shall have Teflon coating or equal.
6. The compressor(s) shall be protected with:

    a. High Pressure switch
    b. Over-current /under current protection
    c. Oil sump sensor
    d. Phase failure
    e. Phase reversal
    f. Compressor shall be capable of receiving injection of medium pressure gas at a point in the compression cycle where such injection shall allow a greater mass flow of refrigerant at lower outdoor ambient and achieving a higher heating capability.. The VRF outdoor unit shall have published_performance data for heating mode operation down to -13F on both heat pump and heat recovery systems.
    g. Standard, non-inverter driven compressors shall not be permitted_nor shall a compressor without vapor injection or direct sump oil return capabilities.

D. Inverter Compressor Controller(s)

1. The VRF outdoor unit shall be provided with a separate inverter compressor controller PCB for each compressor. Inverter compressor controllers that host more than one compressor shall not be accepted.
2. The inverter compressor controller shall be designed and programmed to utilize the entire range of operation of the connected compressor during cooling cycle operation and/or heating cycle operation.
3. Inverter compressor controllers programmed to limit the compressors heating or cooling capacity to reduce or limit power consumption is not acceptable.

E. Condenser Coil: Factory tested

1. Shall be comprised of aluminum fins mechanically bonded to copper tubing.
2. The copper tubes shall have inner riffling to expand the total surface of the tube interior.
3. The aluminum fins shall have factory applied corrosion resistant GoldFin™ material with a Hydrophilic top coat.
4. Coil coating shall be tested in accordance with ASTM B-117 salt spray surface scratch test (SST) procedure for a minimum of 1000 hours. The test report results with photo images shall be included with submittal documentation.
5. Shall have multiple circuits designed for path isolation and variable velocity control.
6. Shall be designed, built and provided by the VRF outdoor unit manufacturer
7. The outdoor unit coil, all indoor units and pipe network shall be field tested to a minimum pressure of 550 psig. Manufacturers that do not specify and/or allow field testing at 550 psig shall not be allowed.
8. The outdoor unit coil for each cabinet shall have lanced aluminum fins with a maximum fin spacing of no more than 14 Fins per Inch (FPI). All the outdoor unit coils shall be a minimum of 3 rows consisting of staggered tubes for efficient air flow across the heat exchanger.
9. The cabinet shall have a factory installed coil guard

F. Condenser Fans and Drives

1. The fan(s) blades shall be made of Acrylonitrile Butadiene Styrene (ABS) material.
2. The fan(s) motor shall be equipped with permanently lubricated bearings.
3. The fan motor shall be variable speed with a maximum operating speed of 1050 RPM.
4. The fan shall have a raised guard to help prevent contact with moving parts.
5. The cabinet shall have option to redirect the discharge air direction from vertical to horizontal with the addition of optional factory provided air guides.

G. Casings: Galvanized or zinc-coated steel treated and finished with manufacturer's standard paint coating designed for outdoor installation with weather protection for components and controls, and with the following:

1. Removable panels for access to controls, condenser fans, motors, and drives.
2. Plated steel fan guards.
3. Lifting eyes.
4. Removable legs.

H. Sensors

1. Each outdoor unit module shall have

    a. Suction temperature sensor
    b. Discharge temperature sensor
    c. Oil level sensor
    d. High Pressure sensor
    e. Low Pressure sensor
    f. Outdoor temperature sensor
    g. Outdoor unit heat exchanger temperature sensor

I. System shall be capable of an automatic refrigerant charge function for use in both the heat mode and cool mode to ensure the proper amount of refrigerant is installed into the system.

J. System shall consist of one, two or three air source outdoor unit modules conjoined together in the field to result in the capacity specified elsewhere in these documents

K. Factory installed microprocessor controls in the outdoor unit(s), BS unit(s), and indoor unit(s) shall perform functions to optimize the operation of the VRF system and communicate in a daisy chain configuration between outdoor unit and BS unit(s) and indoor unit(s) via RS485 network. Controls shall also be available to control other building systems as required from the VRF control system. DIO/AIO capabilities shall be available as well as a central controller to perform operation changes, schedules and other duties

L. **Integration** Each system shall be able to integrate via open protocol via BACnet IP, allowing third party control and monitoring of the DAIKIN A/C system.

M. The outdoor unit refrigerant circuit shall employ for safety a threaded fusible plug.

N. The unit shall be shipped from the factory fully assembled including internal refrigerant piping, inverter driven compressor(s), controls, contacts, relay(s), fans, power and communications wiring as necessary.

O. Each outdoor unit refrigeration circuit shall include, but not limited to, the following components:

1. Refrigerant strainer(s)
2. Check valve(s)
3. Inverter driven, medium pressure vapor injection, high pressure shell compressors
4. Heat pipe cooled inverter PCB
5. Oil separator(s)
6. Accumulator(s)
7. 4-way reversing valve(s)
8. Vapor injection valve(s)
9. Variable path heat exchanger control valve(s)
10. Oil balancing control
11. Oil Level sensor(s)
12. Electronic expansion valve(s)
13. Sub-cooler (s)
14. High and low side Schrader valve service ports with caps.
15. Service valves

P. Refrigerant Flow Control

a) System shall have a variable flow and path outdoor heat exchanger function to vary the refrigerant flow and volume and path. Control of the variable path circuits shall be based on system operating mode and operating conditions as targeted to manage the efficiency of the system.
b) System shall have a medium pressure gas vapor injection function employed in the heating mode to increase system capacity when the outdoor ambient temperatures are low. The compressor vapor injection flow amount shall be controlled by the VI sub-cooling algorithm reset by discharge gas temperatures of the compressor.
c) System shall have an active refrigerant control and multi section accumulator that dynamically changes the volume of refrigerant circulating in the system based on operating mode and operating conditions to ensure maximum system efficiency.
d) The compressor design shall be of the high pressure shell scroll type where the internal pressure below the suction valves of the compressor shall be same as discharge pressure. The motor shall be cooled by high pressure gas and as a result oil shall be stable and non-foaming increasing the efficiency of the system.
e) The VRF outdoor unit shall include a factory provided and mounted sub-cooler assembly consisting of a double spiral tube-type sub-cooling heat exchanger and EEV providing refrigerant sub-cooling modulation control by fuzzy logic of EEV and by mode of operation to provide capacity and efficiency as required

Q. OIL MANAGEMENT

a) The system shall utilize a high pressure oil return system to ensure a consistent film of oil on all moving compressor parts at all points of operation. Oil is returned to compressor through a separate oil injection pipe directly into the oil sump. Oil returned to the compressor via the suction port of the compressor shall not be allowed
b) Each compressor shall be provided with an independent centrifugal oil separator, designed to extract oil from the oil/refrigerant gas stream leaving the compressor.
c) The system shall have an oil level sensor in the compressor to provide direct oil level sensing data to the main controller.
d) The system shall only initiate an oil return cycle if the sensed oil level is below oil level target values as determined by the microprocessor.
e) A default oil return algorithm shall automatically initiate the oil return mode if the system detects a failure of the oil sump sensor. A fault code shall be reported by the system.
f) Timed oil return operations or systems that do not directly monitor compressor oil level shall not be permitted.
g) Indoor Unit Fan Operation During Oil Return Cycle

1. During oil return cycle indoor units operating in cooling or dry mode shall continue normal operation.
2. During oil return, indoor units that are commissioned with fans set for continuous operation shall maintain normal fan speed unless the leaving air temperature drops, then the fan speed will be reduced to low speed for the remainder of the oil return cycle.

1. During oil return cycle indoor unit fans will cycle off and remain off during oil return cycle while operating in all modes except 4.07.e.1 and 2

R. CAPACITIES AND CHARACTERISTICS

1. Refer to Mechanical schedules on plans for required capacities and other characteristics not noted in the specifications.

S. Refrigerant Pipe Connections:

1. Refer to mechanical plans and manufacturer installation manual for pipe connections and sizing.

T. Fans:

1. Refer to manufacturer installation and operation manual for quantity, size, speed and airflow of fans.

U. Electrical Characteristics:

1. Refer to manufacturer installation and operation manual for details.

2.3 BRANCH SELECTOR (BS)

A. General

1. BS unit shall be designed and manufactured by the same manufacturer of VRF indoor unit(s) and outdoor unit(s).
2. BS unit casing shall be constructed with galvanized steel.
3. BS Unit shall be an intermediate refrigerant control device between the air source outdoor unit and the indoor units to control the systems cooling and heating operation.
4. Each port shall be capable of operating in cooling or heating independently regardless of the operating mode of any other port on the BS unit or in the system.
5. BS unit shall be internally piped, wired, assembled and run tested at the factory.
6. BS unit shall be designed for installation in a conditioned environment per specifications.

7. BS unit shall have a balancing valve to control the pressure between the high pressure and low pressure pipe during mode switching to minimize any change-over pressure related sounds.
8. BS unit shall employ an electronic expansion valve to ensure proper sub cooling of the refrigerant.
9. BS unit shall be internally factory insulated.
10. All field refrigerant lines between outdoor unit and BS unit and from BS unit to indoor unit shall be field ACR tubing, insulated per building or energy code and as instructed by the manufacture.
11. The VRF manufacturer shall provide published documentation that specifically allows the installation of field provided isolation valves on all pipes connected to the Heat Recovery unit to allow the servicing of BS units, refrigerant circuit or the replacement of BS unit without evacuating the balance of the piping system.

B. Controls

1. BS unit(s) shall have factory installed unit mounted control boards and integral microprocessor to communicate with other devices in the VRF system.
2. BS unit shall communicate with the indoor units via a 2-conductor shielded communications cable terminated using a daisy chain configuration.(see instructions regarding the termination of the shield)
3. The contractor is instructed to review the Electrical and ATC drawings and specifications for other items or tasks which this contractor is or may be responsible to provide materials and or labor under this contract. Failure to do so will not relieve this contractor of their responsibility to provide such materials and or labor and in no case shall this contractor be further compensated as a result

2.4 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Enclosure Type: Totally enclosed, fan cooled.
2. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
3. Mount unit-mounted disconnect switches on interior of unit.

2.5 SOURCE QUALITY CONTROL

A. Testing Requirements: Factory test sound-power-level ratings according to ARI 270.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb, firmly anchored in locations indicated; maintain manufacturer's recommended clearances.

B. Maintain manufacturer's recommended clearances for service and maintenance.

C. Loose Components: Install electrical components, devices, and accessories that are not factory mounted.

3.2 CONNECTIONS

A. Install piping adjacent to machine to allow service and maintenance.

B. Refrigerant Piping: Connect piping to unit with pressure relief, service valve, filter-dryer, and moisture indicator on each refrigerant-circuit liquid line. Refrigerant piping and specialties are specified in Section 232300 "Refrigerant Piping."

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Perform electrical test and visual and mechanical inspection.
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 motor rotation and unit operation. Complete manufacturer's starting checklist.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
5. Verify proper airflow over coils.

C. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

D. Air-cooled refrigerant condensers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 236313

SECTION 236314 – VARIABLE REFRIGERANT FLOW INDOOR FAN COIL UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes ducted and ductless refrigerant fan coil units and accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

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.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale and coordinated with each other based on input from installers of the items involved:

B. Seismic Qualification Certificates: For fan coil units, accessories, and components, from manufacturer.

C. Field quality-control reports.

D. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

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. Factory-packaged and -tested units rated according to AHRI 440, ASHRAE 33, and UL 1995.

2.2 DUCTLESS FAN COIL UNITS

A. Manufacturers: available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
   1. Daikin
   2. LG Electronics
   3. Or Equivalent

B. Casing
   1. Galvanized steel with coated enamel. Provide with 1/2" polystyrene insulation with anti-microbial coating.

C. Fan Assembly and Control
   1. Single, direct-drive, crossflow tangential fan
   2. Constructed with high strength ABS BSN-7530 polymeric resin or equal
   3. Fan motor shall be brushless digitally controlled design with permanently lubricated and sealed ball bearing
   4. Fan/motor assembly shall be mounted on vibration attenuating rubber grommets
   5. Fan impeller shall be statically and dynamically balanced
   6. Fan speed shall be controlled using a microprocessor-based direct digital control algorithm

D. Coils
   1. Constructed with copper tubes with slit coil fins, two rows, eighteen fins per inch.

E. Filters: Minimum arrestance and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2 and all addendums.

   1. MERV Rating: 8 when tested according to ASHRAE 52.2.
   2. 100% Non-woven media manufactured from recyclable material.
   3. Pleated Cotton-Polyester Media: 90 percent arrestance and MERV 7.

F. Control devices and operational sequences are specified in Section 230923 "Direct Digital Control (DDC) System for HVAC"

G. Basic Unit Controls:

   1. Wall-mounting temperature sensor.
   2. Unoccupied-period-override push button.
   3. Data entry and access port.

      a. Input data includes room temperature and humidity set points and occupied and unoccupied periods.
      b. Output data includes room temperature, operating mode, and status.

H. Terminal Controller:

   1. Scheduled Operation: Occupied and unoccupied periods on seven-day clock with a minimum of four programmable periods per day.

2. Unoccupied-Period-Override Operation: Two hours.
3. Unit Supply-Air Fan Operation:

    a. Occupied Periods: Fan runs continuously.
    b. Unoccupied Periods: Fan cycles to maintain room setback temperature.

4. Controller shall have volatile-memory backup.

I. Electrical Connection: Factory wire motors and controls for a single electrical connection.

J. Capacities and Characteristics:

1. Refer to mechanical schedules for details.

2.3 DUCTED FAN COIL UNITS

A. Manufacturers: available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
1. Daikin
2. LG Electronics
3. Or Equivalent

B. Casing
1. Unit case to be 22-gauge coated galvanized steel and the external surfaces to be finished with a high gloss baked enamel finish. Provide with 1/2" foil faced, polystyrene fiber insulation.
2. All access panels to be provided with gasket seals to minimize leakage.

C. Fan Assembly and Control
1. Integral, direct-drive fan with galvanized steel housing and a forward-curved fan wheel.
2. Fan motor shall be brushless digitally controlled design with permanently lubricated and sealed ball bearing
3. Fan/motor assembly shall be mounted on vibration attenuating rubber grommets
4. Fan motor shall have thermal, overcurrent and RPM protection.
5. Fan impeller shall be statically and dynamically balanced
6. Fan speed shall be controlled using a microprocessor-based direct digital control algorithm

D. Coils
1. Constructed with copper tubes with slit coil fins, two to three rows, eighteen fins per inch.

E. Filters: Minimum arrestance and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2 and all addendums.

1. MERV Rating: 8 when tested according to ASHRAE 52.2.
2. 100% Non-woven media manufactured from recyclable material.
3. Pleated Cotton-Polyester Media: 90 percent arrestance and MERV 7.

F. Control devices and operational sequences are specified in Section 230923 "Direct Digital Control (DDC) System for HVAC"

G. Basic Unit Controls:

1. Wall-mounting temperature sensor.
2. Unoccupied-period-override push button.
3. Data entry and access port.

    a. Input data includes room temperature and humidity set points and occupied and unoccupied periods.
    b. Output data includes room temperature, operating mode, and status.

H. Terminal Controller:

1. Scheduled Operation: Occupied and unoccupied periods on seven-day clock with a minimum of four programmable periods per day.
2. Unoccupied-Period-Override Operation: Two hours.
3. Unit Supply-Air Fan Operation:

    a. Occupied Periods: Fan runs continuously.
    b. Unoccupied Periods: Fan cycles to maintain room setback temperature.

4. Controller shall have volatile-memory backup.

I. Electrical Connection: Factory wire motors and controls for a single electrical connection.

J. Capacities and Characteristics:

1. Refer to mechanical schedules for details.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fan coil units level and plumb.

B. Install fan coil units to comply with NFPA 90A.

C. Suspend fan coil units from structure with threaded rod hangers. Vibration isolators are specified in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."

D. Verify locations of thermostats, and other exposed control sensors with Drawings and room details before installation. Refer to architectural or mechanical plans for mounting details.

E. Install new filters in each fan coil unit within two weeks after Substantial Completion.

F. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:

1. Install piping adjacent to machine to allow service and maintenance.
2. Connect condensate drain to indirect waste.

    a. Install condensate trap of adequate depth to seal against fan pressure. Install cleanouts in piping at changes of direction.

G. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

H. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After electrical circuitry, has been energized, start units to confirm proper motor rotation and unit operation.
2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace malfunctioning units and retest as specified above.

C. Prepare test and inspection reports.

3.3 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

END OF SECTION 238219

SECTION 237413 - PACKAGED, OUTDOOR, CENTRAL-STATION AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes packaged, outdoor, central-station air-handling units (rooftop units) with the following components and accessories:

1. Direct-expansion cooling.
2. Hot-gas reheat.
3. Gas furnace.
4. Economizer outdoor- and return-air damper section.
5. Integral, space temperature controls.
6. Roof curbs.

1.3 DEFINITIONS

A. DDC: Direct-digital controls.

B. ECM: Electrically commutated motor.

C. 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.

D. Outdoor-Air Refrigerant-Coil Fan: The outdoor-air refrigerant-coil fan in RTUs. "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, outdoor, central-station air-handling 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.

H. VVT: Variable-air volume and temperature.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design RTU supports to comply with seismic performance requirements, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Seismic Performance: RTUs shall withstand the effects of earthquake motions determined according to SEI/ASCE 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."

1.5 ACTION SUBMITTALS

A. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Structural members to which RTUs will be attached.
2. Roof openings
3. Roof curbs and flashing.

B. Field quality-control test reports.

C. Warranty: Special warranty specified in this Section.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fan Belts: One set for each belt-driven fan.

1.9 QUALITY ASSURANCE

A. ARI Compliance:

1. Comply with ARI 210/240 and ARI 340/360 for testing and rating energy efficiencies for RTUs.
2. Comply with ARI 270 for testing and rating sound performance for RTUs.

B. ASHRAE Compliance:

1. Comply with ASHRAE 15 for refrigeration system safety.
2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.

3. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

D. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.

E. UL Compliance: Comply with UL 1995.

F. 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.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to 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 Gas Furnace Heat Exchangers: Manufacturer's standard, but not less than 10 years from date of Substantial Completion.
3. Warranty Period for Solid-State Ignition Modules: Manufacturer's standard, but not less than three years from date of Substantial Completion.
4. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide [the product indicated on Drawings] <Insert manufacturer's name; product name or designation> or a comparable product by one of the following:

1. Daikin

2. AAON, Inc.

2.2 CASING

A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.

B. Exterior Casing Material: Galvanized steel with factory-painted finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.

1. Exterior Casing Thickness: 0.052 inch (1.3 mm) thick.

C. Inner Casing Fabrication Requirements:

1. Inside Casing: Galvanized steel, 0.034 inch (0.86 mm) thick

2. Inside Casing (100%OSA Units): Stainless steel, 0.034 inch (0.86 mm) thick

D. Casing Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.

1. Materials: ASTM C 1071, Type I.
2. Thickness: 1 inch (25 mm).
3. Liner materials shall have air-stream surface coated with an erosion- and temperature-resistant coating or faced with a plain or coated fibrous mat or fabric.
4. Liner Adhesive: Comply with ASTM C 916, Type I.

E. Condensate Drain Pans: Formed sections of stainless-steel sheet, a minimum of 2 inches (50 mm) deep, and complying with ASHRAE 62.1.

1. Double-Wall Construction: Fill space between walls with foam insulation and seal moisture tight.
2. Drain Connections: Threaded nipple.
3. Pan-Top Surface Coating: Corrosion-resistant compound.

F. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

2.3 FANS

A. Direct-Driven Supply-Air Fans: Double width, forward curved, centrifugal; with permanently lubricated, motor resiliently mounted in the fan inlet. Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls.

B. Belt-Driven Supply-Air Fans: Double width, forward curved, centrifugal; with permanently lubricated, single-speed motor installed on an adjustable fan base resiliently mounted in the casing. Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls.

C. Condenser-Coil Fan: Propeller, mounted on shaft of permanently lubricated motor.

D. Relief-Air Fan: Forward curved, shaft mounted on permanently lubricated motor.

E. Seismic Fabrication Requirements: Fabricate fan section, internal mounting frame and attachment to fans, fan housings, motors, casings, accessories, and other fan section components with reinforcement strong enough to withstand seismic forces defined in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment" when fan-mounted frame and RTU-mounted frame are anchored to building structure.

F. Fan Motor: Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.4 COILS

A. Refrigerant Coils:

1. Copper-plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.
2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.
3. Coil Split: Interlaced.

2.5 REFRIGERANT CIRCUIT COMPONENTS

A. Compressor: , mounted on neoprene vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief

B. Refrigeration Specialties:
1. Refrigerant: R-407C or R-410A.
2. Expansion valve with replaceable thermostatic element.
3. Refrigerant filter/dryer.
4. Manual-reset high-pressure safety switch.
5. Automatic-reset low-pressure safety switch.
6. Minimum off-time relay.
7. Automatic-reset compressor motor thermal overload.
8. Brass service valves installed in compressor suction and liquid lines.
9. Low-ambient kit high-pressure sensor.
10. Hot-gas reheat solenoid valve with a replaceable magnetic coil.
11. Hot-gas bypass solenoid valve with a replaceable magnetic coil.
12. Four-way reversing valve with a replaceable magnetic coil, thermostatic expansion valves with bypass check valves, and a suction line accumulator.

2.6 AIR FILTRATION

A. Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2. Refer to Mechanical plans and schedules for requirements.

2.7 GAS FURNACE (where applicable)

A. Description: Factory assembled, piped, and wired; complying with ANSI Z21.47 and NFPA 54.

1. CSA Approval: Designed and certified by and bearing label of CSA.

B. Burners: Stainless steel.

C. Heat-Exchanger and Drain Pan: Stainless steel.

D. Venting: Gravity vented.

E. Safety Controls:

1. Gas Control Valve: Modulating.
2. Gas Train: Single-body, regulated, redundant, 24-V ac gas valve assembly containing pilot solenoid valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff.

2.8 DAMPERS

A. Outdoor- and Return-Air Mixing Dampers: Parallel- or opposed-blade galvanized-steel dampers mechanically fastened to cadmium plated for galvanized-steel operating rod in reinforced cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously.

1. Damper Motor: Modulating with adjustable minimum position.
2. Relief-Air Damper: Gravity actuated or motorized, as required by ASHRAE/IESNA 90.1, with bird screen and hood.

2.9 ELECTRICAL POWER CONNECTION

A. Provide for single connection of power to unit with control-circuit transformer with built-in overcurrent protection.

2.10 CONTROLS

A. Control equipment and sequence of operation are specified in Section 230900 "Instrumentation and Control for HVAC."

2.11 ACCESSORIES

A. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required. Outlet shall be energized even if the unit main disconnect is open.

B. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.

C. Coil guards of painted, galvanized-steel wire.

D. Hail guards of galvanized steel, painted to match casing.

E. Concentric diffuser with white louvers and polished aluminum return grilles, insulated diffuser box with mounting flanges, and interior transition.

2.12 ROOF CURBS

A. Roof curbs with vibration isolators and wind or seismic restraints are specified in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."

2.13 CAPACITIES AND CHARACTERISTICS.

A. Refer to mechanical plans and schedules for capacities and characteristics.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of 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.

3.2 INSTALLATION

A. Roof Curb: Install on roof structure or concrete base, level and secure, according to NRCA's "Low-Slope Membrane Roofing Construction Details Manual," Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts.". 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.

3.3 CONNECTIONS

A. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.

B. Install piping adjacent to RTUs to allow service and maintenance.

1. Gas Piping: Comply with applicable requirements in Section 231123 "Facility Natural-Gas Piping." Connect gas piping to burner, full size of gas train inlet, and connect with union and shutoff valve with sufficient clearance for burner removal and service.

C. Duct installation requirements are specified in other HVAC Sections. Drawings indicate the 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.

3.4 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. Report results in writing.

B. Perform tests and inspections and prepare test reports.

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. Report results in writing.

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. Remove and replace malfunctioning units and retest as specified above.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions and do the following:

1. Inspect for visible damage to unit casing.
2. Inspect for visible damage to furnace combustion chamber.
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. Clean furnace flue and inspect for construction debris.
11. Connect and purge gas line.
12. Remove packing from vibration isolators.
13. Inspect operation of barometric relief dampers.
14. Verify lubrication on fan and motor bearings.
15. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
16. Adjust fan belts to proper alignment and tension.
17. 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.

18. Inspect and record performance of interlocks and protective devices; verify sequences.
19. Operate unit for an initial period as recommended or required by manufacturer.
20. Perform the following operations for both minimum and maximum firing. Adjust burner for peak efficiency.

    a. Measure gas pressure on manifold.
    b. Inspect operation of power vents.
    c. Measure combustion-air temperature at inlet to combustion chamber.
    d. Measure flue-gas temperature at furnace discharge.
    e. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
    f. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.

21. Calibrate thermostats.
22. Adjust and inspect high-temperature limits.
23. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
24. 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.

25. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
26. 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.

27. 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.

28. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:

a. High-temperature limit on gas-fired heat exchanger.
b. Low-temperature safety operation.
c. Filter high-pressure differential alarm.
d. Economizer to minimum outdoor-air changeover.
e. Relief-air fan operation.
f. Smoke and firestat alarms.

29. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

3.6 CLEANING AND ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site during other-than-normal occupancy hours for this purpose.

B. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain RTUs. Refer to Section 017900 "Demonstration and Training."

END OF SECTION 237413

SECTION 237414 - PACKAGED OUTDOOR GAS AND ELECTRIC ROOFTOP UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes packaged, outdoor, central-station air-handling units (rooftop units) with the following components and accessories:
   1. Direct-expansion cooling.
   2. Refrigeration compressor components.
   3. Natural Gas Heat Components
   4. Air supply fans.
   5. Filter box.
   6. Integral, space temperature controls.
   7. Roof curbs.

1.2 DEFINITIONS

A. DDC: Direct-digital controls.

B. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, outdoor, central-station air-handling units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.

1.3 SUBMITTALS

A. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   1. Wiring Diagrams: Power, signal, and control wiring.

C. Coordination Drawings: Plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Structural members to which RTUs will be attached.
   2. Roof openings
   3. Roof curbs and flashing.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals.

F. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

A. ARI Compliance:
   1. Comply with ARI 230/110 and ARI 303/110 for testing and rating energy efficiencies for RTUs.
   2. Comply with ARI 270 for testing and rating sound performance for RTUs.

B. ASHRAE Compliance:
   1. Comply with ASHRAE 15 for refrigeration system safety.
   2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.

3. Comply with applicable requirements in ASHRAE 62.1, Section 5 – “Systems and Equipment” and Section 7 – “Construction and Start-Up”.

C. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

D. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.

E. UL Compliance: Comply with UL 1995.

F. 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.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to 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 Gas Furnace Heat Exchangers: Manufacturer's standard, but not less than five years from date of Substantial Completion.
3. Warranty Period for Solid-State Ignition Modules: Manufacturer's standard, but not less than three years from date of Substantial Completion.
4. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:
1. Carrier Corporation.
2. Trane.
3. YORK International Corporation.
4. Or Equal.

2.2 CAPACITIES AND CHARACTERISTICS

A. Refer to equipment schedules on drawings.

2.3 HVAC Equipment Insulation

A. Decentralized, Rooftop Units:
1. Evaporator fan compartment:
a. Interior cabinet surfaces shall be insulated with a minimum 1/2-in. thick, minimum 1 1/2 lb density, flexible fiberglass insulation bonded with a phenolic binder, neoprene coated on the air side.
b. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.

2.4 Instrumentation and Control Devices for HVAC

1. Sensors and Transmitters
    a. Thermostats
        1) Thermostat must
            a) energize both “W” and “G” when calling for heat.
            b) have capability to energize 2 different stages of cooling, and 2 different stages of heating.
            c) include capability for occupancy scheduling.

2.5 Direct-digital Control system for HVAC

A. Decentralized, Rooftop Units:

1. Unit Controls shall contain:
    a. Four button detailed English scrolling marquee display.
    b. Unit control with standard suction pressure transducers and condensing temperature thermistors.
    c. Shall provide a 5_F temperature difference between cooling and heating set points to meet ASHRAE 90.1 Energy Standard.
    d. Shall provide and display a current alarm list and an alarm history list.
    e. Service run test capability.
    f. Shall accept input from a CO_2 sensor (both indoor and outdoor).
    g. Configurable alarm light shall be provided which activates when certain types of alarms occur.
    h. Compressor minimum run time (3 minutes) and minimum off time (5 minutes) are provided.
    i. Service diagnostic mode.
    j. Economizer control (optional).
    k. Control multi capacity stages
    l. Unit shall be complete with self-contained low voltage control circuit
    m. Unit shall have 0_F low ambient cooling operation.
2. Safeties:
    a. Unit shall incorporate a solid state compressor lockout that provides optional reset capability at the space thermostat, should any of the following safety devices trip and shut off compressor:
        1) Compressor lockout protection provided for either internal or external overload.
        2) Low pressure protection.
        3) Freeze protection (evaporator coil).
        4) High pressure protection (high pressure switch or internal).
        5) Compressor reverse rotation protection
        6) Loss of charge protection.
        7) Supply air sensor shall be located in the unit and detect both heating and cooling operation
3. RTU Open - multi-protocol, direct digital controller:
    a. Shall be ASHRAE 62-2001 compliant.
    b. Shall accept 18-30VAC, 50-60Hz, and consumer 15VA or less power.
    c. Shall have an operating temperature range from -40_F (-40_C) to 130_F (54_C), 10 percent – 90 perecent RH (non-condensing).
    d. Shall include built-in protocol for BACNET (MS/TP and PTP modes), Modbus (RTU and ASCII), Johnson N2 and LonWorks. LonWorks Echelon processor required for all Lon applications shall be contained in separate communication board.
    e. Shall allow access of up to 62 network variables (SNVT). Shall be compatible with all open controllers
    f. Baud rate Controller shall be selectable using a dipswitch.
    g. Shall have an LED display independently showing the status of serial communication, running, errors, power, all digital outputs, and all analog inputs.
    h. Shall accept the following inputs: space temperature, setpoint adjustment, outdoor air temperature, indoor air quality, outdoor air quality, compressor lock-out, fire shutdown, enthalpy switch, and fan status/filter status/ humidity/ remote occupancy.
    i. Shall provide the following outputs: economizer, fan, cooling stage 1, cooling stage 2, heat stage 1, heat stage 2, heat stage 3/ exhaust/ reversing valve.
    j. Shall have built-in surge protection circuitry through solid state polyswitches. Polyswitches shall be used on incoming power and network connections. Polyswitches will return to normal when the “trip” condition clears.

k. Shall have a battery back-up capable of a minimum of 10,000 hours of data and time clock retention during power outages.
l. Shall have built-in support for technician tool.
m. Shall include an EIA-485 protocol communication port, an access port for connection of either a computer or a Carrier technician tool, an EIA-485 port for network communication to intelligent space sensors and displays, and a port to connect an optional LonWorks communications card.
n. Software upgrades will be accomplished by either local or remote download. No software upgrades through chip replacements are allowed.

2.6 Electric and Electronic Control System for HVAC

A. Decentralized, Rooftop Units:
1. General:
a. Shall be complete with self-contained low-voltage control circuit protected by a resettable circuit breaker on the 24-v transformer side. Transformer shall have 75VA capability.
b. Shall utilize color-coded wiring.
c. Shall include a central control terminal board to conveniently and safely provide connection points for vital control functions such as: smoke detectors, phase monitor, gas controller, economizer, thermostat, DDC control options, and low and high pressure switches.
d. The heat exchanger shall be controlled by an integrated gas controller (IGC) microprocessor. See heat exchanger section of this specification.
e. Unit shall include a minimum of one 8-pin screw terminal connection board for connection of control wiring.
2. Safeties:
a. Compressor over-temperature, over-current. High internal pressure differential.
b. Low-pressure switch.
1) Units with 2 compressors shall have different sized connectors for the circuit 1 and circuit 2 low and high pressure switches. They shall physically prevent the cross-wiring of the safety switches between circuits 1 and 2.
2) Low pressure switch shall use different color wire than the high pressure switch. The purpose is to assist the installer and service technician to correctly wire and or troubleshoot the rooftop unit.
c. High-pressure switch.
1) Units with 2 compressors shall have different sized connectors for the circuit 1 and circuit 2 low and high pressure switches. They shall physically prevent the cross-wiring of the safety switches between circuits.
2) High pressure switch shall use different color wire than the low pressure switch. The purpose is to assist the installer and service technician to correctly wire and or troubleshoot the rooftop unit.
d. Automatic reset, motor thermal overload protector
1) High-temperature limit switches.
2) Induced draft motor speed sensor.
3) Flame rollout switch
4) Flame proving controls.
e. Heating section shall be provided with the following minimum protections:

2.7 Sequence of Operations for HVAC Controls

A. Decentralized, Rooftop Units:

B. See 230900 Instrumentation and Control

2.8 Panel Air Filters

A. Decentralized, Rooftop Units:
1. Standard filter section
a. Shall consist of factory-installed, low velocity, disposable 2-in. thick fiberglass filters of commercially available sizes.

b. Unit shall use only one filter size. Multiple sizes are not acceptable.
c. Filters shall be accessible through an access panel with “no-tool” removal as described in the unit cabinet section of this specification (23 81 19.13.H).

2.9 Coils

A. E-coated aluminum-fin evaporator and condenser coils:
1. Shall have a flexible epoxy polymer coating uniformly applied to all coil surface areas without material bridging between fins.
2. Coating process shall ensure complete coil encapsulation of tubes, fins and headers.
3. Color shall be high gloss black with gloss per ASTM D523-89.
4. Uniform dry film thickness from 0.8 to 1.2 mil on all surface areas including fin edges.
5. Superior hardness characteristics of 2H per ASTM D3363-92A and cross-hatch adhesion of 4B-5B per ASTM D3359-93.
6. Impact resistance shall be up to 160 in.-lb (ASTM D2794-93).
7. Humidity and water immersion resistance shall be up to minimum 1000 and 250 hours respectively (ASTM D2247-92 and ASTM D870-92).
8. Corrosion durability shall be confirmed through testing to be no less than 1000 hours salt spray per ASTM B117-90.

2.10 Refrigerant Components

A. Refrigerant circuit shall include the following control, safety, and maintenance features:
1. Thermostatic Expansion Valve (TXV) shall help provide optimum performance across the entire operating range. Shall contain removable power element to allow change out of power element and bulb without removing the valve body.
2. Refrigerant filter drier - Solid core design.
3. Service gauge connections on suction and discharge lines.
4. Pressure gauge access through a specially designed access port in the top panel of the unit.

B. There shall be gauge line access port in the skin of the rooftop, covered by a black, removable plug.
1. The plug shall be easy to remove and replace.
2. When the plug is removed, the gauge access port shall enable maintenance personnel to route their pressure gauge lines.
3. This gauge access port shall facilitate correct and accurate condenser pressure readings by enabling the reading with the compressor access panel on.
4. The plug shall be made of a leak proof, UV-resistant, composite material.

C. Compressors
1. Unit shall use fully hermetic, scroll compressor for each independent refrigeration circuit.
2. Models shall be available with two stage capacity control.
3. Compressor motors shall be cooled by refrigerant gas passing through motor windings.
4. Compressors shall be internally protected from high discharge temperature conditions.
5. Compressors shall be protected from an over-temperature and over-amperage conditions by an internal, motor overload device.
6. Compressor shall be factory mounted on rubber grommets.
7. Compressor motors shall have internal line break thermal, current overload and high pressure differential protection.
8. Crankcase heaters shall be standard on each compressor.

2.11 Natural Gas Heat Exchanger.

A.General

1. Heat exchanger shall be an induced draft design. Positive pressure heat exchanger designs shall not be allowed.

2.Shall incorporate a direct-spark ignition system and redundant main gas valve.

3. Gas supply pressure at the inlet to the rooftop unit gas valve must match that required by the manufacturer.

B.The heat exchanger shall be controlled by an integrated gas controller (IGC) microprocessor.

1.IGC board shall notify users of fault using an LED (light-emitting diode).

2.The LED shall be visible without removing the control box access panel.

3.IGC board shall contain algorithms that modify evaporator-fan operation to prevent future cycling on high temperature limit switch.

4.Unit shall be equipped with anti-cycle protection with one short cycle on unit flame rollout switch or 4 continuous short cycles on the high temperature limit switch. Fault indication shall be made using an LED.

C. Stainless Steel Heat Exchanger construction

1. Use energy saving, direct-spark ignition system.

2.Use a redundant main gas valve.

3.Burners shall be of the in-shot type constructed of aluminum-coated steel.

4.All gas piping shall enter the unit cabinet at a single location on side of unit (horizontal plane).

5.The optional stainless steel heat exchanger shall be of the tubular-section type, constructed of a minimum of 20-gauge type 409 stainless steel.

6.Type 409 stainless steel shall be used in heat exchanger tubes and vestibule plate.

7.Complete stainless steel heat exchanger allows for greater application flexibility.

D.Low NOx Heat Exchanger construction

1.Low NOx reduction shall be provided to reduce nitrous oxide emissions to meet California's Air Quality Management District (SCAQMD) low-NOx emissions requirement of 40 nanograms per joule or less.

2.Primary tubes and vestibule plates on low NOx units shall be 409 stainless steel. Other components shall be aluminized steel.

E.Induced draft combustion motor and blower

1.Shall be a direct-drive, single inlet, forward-curved centrifugal type.

2.Shall be made from steel with a corrosion-resistant finish.

3.Shall have permanently lubricated sealed bearings.

4.Shall have inherent thermal overload protection.

5.Shall have an automatic reset feature.

2.11 Filter Section

A. Filters access is specified in the unit cabinet section of this specification.

B. Filters shall be held in place by a pivoting filter tray, facilitating easy removal and installation.

C. Shall consist of factory-installed, low velocity, throw-away 2-in. thick fiberglass filters.

D. Filters shall be standard, commercially available sizes.

E. Only one size filter per unit is allowed.

2.12 Evaporator Fan and Motor

A. Evaporator fan motor:
   1. Shall have permanently lubricated bearings.
   2. Shall have inherent automatic-reset thermal overload protection or circuit breaker.
   3. Shall have a maximum continuous bhp rating for continuous duty operation; no safety factors above that rating shall be required.

B. Belt-driven Evaporator Fan with VFD controller and display:
   1. Belt drive shall include an adjustable-pitch motor pulley.
   2. Shall use sealed, permanently lubricated ball-bearing type.
   3. Blower fan shall be double-inlet type with forward-curved blades.
   4. Shall be constructed from steel with a corrosion resistant finish and dynamically balanced.
   5. Shall come with factory installed Variable Frequency Drive (VFD):
      a. Shall be installed inside the unit cabinet, mounted, wired and tested
      b. Shall contain Electromagnetic Interference (EMI) suppression (also called radio frequency interference or RFI) that may interrupt, obstruct, or otherwise degrade the effective performance of the internal circuit.
      c. Insulated Gate Bi-Polar Transistors (IGBT) used to produce the output pulse width modulated (PWM) waveform, allowing for quiet motor operation.
      d. Be self diagnostics

e. RS485 capability standard.
f. Electronic thermal overload protection.
g. 5 percent swinging chokes for harmonic reduction and improved power factor.
h. All printed circuit boards shall be conformal coated

2.13 Condenser Fans and Motors

A. Condenser fan motors:
1. Shall be a totally enclosed motor.
2. Shall use permanently lubricated bearings.
3. Shall have inherent thermal overload protection with an automatic reset feature.
4. Shall use a shaft-down design.
5. Shall be ECM design.

B. Condenser Fans:
1. Shall be a direct-driven propeller type fan.
2. Shall have aluminum blades riveted to corrosion-resistant steel spiders and shall be dynamically balanced.

2.14 Special Features and Accessories

A. Roof Curbs (Vertical):
1. Full perimeter roof curb with exhaust capability providing separate air streams for energy recovery from the exhaust air without supply air contamination.
2. Formed galvanized steel with wood nailer strip and shall be capable of supporting entire unit weight.
3. Permits installation and securing of ductwork to curb prior to mounting unit on the curb.

B. Time Guard
1. Shall prevent compressor short cycling by providing a 5-minute delay (□2 minutes) before restarting a compressor after shutdown for any reason.
2. One device shall be required per compressor.

C. Hinged Access Panels
1. Shall provide easy access through integrated quarter turn latches and lift tabs.
2. Shall be on major panels of – filter, control box, fan motor and compressor.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of 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.

3.2 INSTALLATION

A. Roof Curb: Install on roof structure or concrete base, level and secure, according to architectural and structural plans and specifications and NRCA's "Low-Slope Membrane Roofing Construction Details

Manual," Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." 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.

3.3 CONNECTIONS

A. Install condensate drain, minimum connection size, with trap and indirect connection to nearest approved receptor per plumbing plans.

B. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate the 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.

3.4 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. Report results in writing.

B. Perform tests and inspections and prepare test reports..

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. Remove and replace malfunctioning units and retest as specified above.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions and do the following:
   1. Inspect for visible damage to unit casing.
   2. Inspect for visible damage to compressor, coils, and fans.
   3. Inspect internal insulation.
   4. Verify that labels are clearly visible.
   5. Verify that clearances have been provided for servicing.
   6. Verify that controls are connected and operable.
   7. Verify that filters are installed.
   8. Clean condenser coil and inspect for construction debris.
   9. Remove packing from vibration isolators.
   10. Inspect operation dampers.
   11. Verify lubrication on fan and motor bearings.
   12. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
   13. Adjust fan belts to proper alignment and tension.

14. 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.
15. Inspect and record performance of interlocks and protective devices; verify sequences.
16. Operate unit for an initial period as recommended or required by manufacturer.
17. Calibrate thermostats.
18. Adjust and inspect high-temperature limits.
19. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
20. Start refrigeration system and measure and record the following when ambient is a minimum of 15 deg F 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.
21. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
22. 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.
23. 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.
24. Verify operation of remote panel including 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. Made from steel with a corrosion-resistant finish.
25. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

3.6 CLEANING AND ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site during other-than-normal occupancy hours for this purpose.

B. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train maintenance personnel to adjust, operate, and maintain RTUs.

END OF SECTION 237414

SECTION 237433 - DEDICATED OUTDOOR-AIR UNITS - KITCHEN

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes Packaged Make-Up Air Units with integral Indirect Gas-Fired heating with cooling for outdoor installation. Integral cooling source shall be DX Cooling. Airflow arrangement shall be Outdoor Air with Variable Volume.

1.2 SUBMITTALS

A. Product Data: For each type or model, include the following:

1. Complete fan performance curves for Supply Air, with system operating conditions indicated, as tested in an AMCA Certified Chamber.
2. Sound performance data for Supply Air, as tested in an AMCA Certified chamber.
3. Motor ratings, electrical characteristics and motor and fan accessories.
4. Dimensioned drawings for each type of installation, showing isometric and plan views, to include location of attached ductwork and service clearance requirements.
5. Estimated gross weight of each installed unit.
6. Installation, Operating and Maintenance manual (IOM) for each model.
7. Remote Panel description to include all functions.

A. Shop Drawings: Include plans, elevations, sections, and attachment details.

1.3 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 for each belt-driven fan.
2. Filters: One set for each unit.

1.4 WARRANTY

A. Special Warranty: Manufacturer agrees to replace components of units that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Compressors: Five years from date of Substantial Completion.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain Packaged Make-Up Air Unit with Integral Heating and Cooling with all appurtenant components or accessories from a single manufacturer.

B. Product Options: Drawings must indicate size, profiles and dimensional requirements of Make-Up Air Units and are to be based on the specific system indicated.

C. Certifications

1. Entire unit shall be ETL Certified per U.L. 1995 and bear an ETL mark.
2. Indirect gas-fired heaters shall be ETL certified as a component of the unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Accurex, LLC.
2. Greenheck Fan Corporation.

2.2 REQUIREMENTS

A. Unit with Integral Indirect gas-fired Heating and Evaporative Cooling shall be fully assembled at the factory and consist of an insulated metal cabinet, curb assembly, motorized intake damper, evaporative cooling module, condensate drain pan, P trap, sensors, supply air blower assembly, and electrical control unit with all specified components and internal accessories factory installed and tested and prepared for single-point high voltage connection.

B. A curb assembly made of 14-gauge galvanized steel shall be provided by the factory for assembly and installation as part of this division. The curb assembly shall provide perimeter support of the entire unit and shall have duct adapters for supply air. Curb assembly shall enclose the underside of the unit and shall be sized to fit into a recess in the bottom of the unit. Contractor shall be responsible for coordinating with roofing contractor to ensure curb unit is properly flashed to provide protection against weather/moisture penetration. Contractor shall provide and install appropriate insulation for the curb assembly.

2.3 CABINET

A. Materials: Formed, single wall metal cabinet with fiberglass duct liner insulation, fabricated to permit access to internal components for maintenance.

1. Outside casing: 18 gauge, galvanized (G90) steel meeting ASTM A653 for components that do not receive a painted finish. Pre-painted components as supplied by the factory shall have polyester urethane paint on 18 gauge G60 galvanized steel. Base rail is 12 gauge, galvanized (G90) steel.
2. Internal Assemblies: 24 gauge galvanized (G90) steel except for motor supports which shall be minimum 14 gauge galvanized (G90) steel.

B. Comply with NFPA 90A and NFPA 90B and erosion requirements of UL 181.

1. Materials: Fiberglass insulation. If insulation other than fiberglass is used, it must also meet the Fire Hazard Classification shown below.

a. Thickness: 1 inch (25 mm).
b. Fire Hazard Classification: Maximum flame spread of 25 and smoke developed of 50, when tested in accordance with ASTM C 411.
c. Location and application: Floor of each unit shall be insulated with either one half inch thick or 1 inch thick rigid fiberglass insulation, covered on one surface with integral aluminum foil.

C. Access panels: Unit shall be equipped with removable access panels to provide easy access to all major components. Access panels shall be fabricated of 18 gauge steel. Removable access panels shall incorporate of formed drip edge.

2.4 SUPPLY FAN

A. Blower section construction, Supply Air: Belt drive motor and blower shall be assembled onto a minimum 14-gauge galvanized steel platform and must have neoprene vibration isolation devices, minimum of 1 – 1/8 inches thick.

B. Blower assemblies: Shall be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower.

C. Centrifugal blower housing: Formed and reinforced steel panels to make curved scroll housing with shaped cutoff.

D. Forward curved blower (fan) wheels: Galvanized or aluminum construction with inlet flange and shallow blades curved forward in direction of airflow. Mechanically attached to shaft with set screws.

E. Supply Air blower assembly: Blower assembly consists of an electric motor and a belt driven, double inlet forward curve blower. Assembly shall be mounted on heavy gauge galvanized rails and further mounted on minimum 1.125 inch thick neoprene vibration isolators.

F. Blower section motor source quality control: Blower performance shall be factory tested for flow rate, pressure, power, air density, rotation speed and efficiency, Rating are to be established in accordance with AMCA 210, “Laboratory Methods of Testing Fans for Rating”.

2.5 MOTORS

A. General: Blower motors greater than .75 horsepower shall be “NEMA Premium” unless otherwise indicated. Compliance with EPAct minimum energy-efficiency standards for single speed ODP and TE enclosures is not acceptable. Motors shall be heavy-duty, permanently lubricated type to match the fan load and furnished at the specified voltage, phase and enclosure. Drives shall be sized for a minimum of 150% of driven horsepower and pulleys shall be fully machined cast-type, keyed and fully secured to the fan wheel and motor shafts. Electric motors of ten horsepower or less shall be supplied with an adjustable drive pulley.

2.6 INDIRECT GAS-FIRED FURNANCE:

A. Shall be ETL Certified as a component of the unit.

B. Shall have an integral combustion gas blower.

C. Shall be ETL Certified for installation downstream of a cooling coil.

D. Shall have fault sensors to provide fault conditions to optional digital controller or building controls.

E. Shall have 4-pass tubular heat exchangers, constructed of type 409 stainless steel. Heat exchanger tubes shall be installed on the vest plate by means of swaged assembly, welded connections are not acceptable. Heat exchanger tubes shall be supported by a minimum of two fabricated assemblies that support the tubes and also permit expansion and contraction of the tubes.

F. Heat exchanger shall have a one year warranty.

G. Shall be encased in a weather-tight metal housing with intake air vents. Large, metal lift-off or hinged door shall provide easy access to the enclosed vest plate, control circuitry, gas train burner assembly and exhaust blower.

H. Shall include a kit for Outdoor mounting with Standard venting.

2.7 DX COOLING MODULE

A. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

a. Compressor Type: Scroll.
b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
c. Refrigerant Charge: R-410A
d. Refrigerant Coil: Copper tube, with mechanically bonded cooper fins and liquid subcooler. Comply with ARI 210/240.
e. Hot gas bypass

B. Condensate Drain Pan. Drain Pan shall be an integral part of the MAU whenever a cooling option is included. Pan shall be formed of welded austenitic stainless steel sheet material and provided with a welded stainless steel drain connection at the front for connection to a P trap. Drain pan shall be sloped in two directions to provide positive draining and drain connector shall be sealed at penetration through cabinet wall

2.8 OUTDOOR-AIR INTAKE HOOD

A. Type: Manufacturer’s standard hood or louver.

B. Materials: Match cabinet.

C. Bird Screen: Comply with requirements in ASHRAE 6.

D. Configuration: Designed to inhibit wind-driven rain and snow from entering unit.

2.9 FILTERS

A. Cleanable Filters: 2-inch-thick, cleanable metal mesh.

B. Mounting Frames:

1. Panel filters arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or from access plenum.

2.10 CONTROLS

A. Control panel / connections: Unit shall have an electrical control center where all high and low voltage connections are made. Control center shall be constructed to permit single-point high voltage power supply connections.

B. Control Wiring: Factory wire connection for controls' power supply.

C. Control Devices: Sensors, transmitters, relays, switches, detectors, operators, and actuators shall be manufacturer's standard items to accomplish indicated control functions.

D. The unit shall be constructed so that it can function as a stand-alone heating and cooling system controlled by factory-supplied controllers, thermostats and sensors or it can be operated as heating and cooling system controlled by a Building Management System (BMS).

E. Remote Panel: Manufacturer shall provide and contractor shall install an Industrial type remote panel that functions as a remote indicator of owner-selected operating parameters and also permits remote inputting of new operating parameters.

F. Sensors to be provided with the unit include:

1. Heating Inlet Air Sensor.

G. Control Dampers:

1. Dampers: Motorized Intake Air dampers of low leakage type shall be factory installed.

2. Damper Location: Factory installed inside unit for ease of blade axle and bushing service. Arrange dampers located in a mixing box to achieve convergent airflow to minimize stratification.
3. Damper Leakage: Comply with requirements in AMCA 500-D. Leakage shall not exceed 6.5 cfm per sq. ft. at a static-pressure differential of 4.0 inches water column when a torque of 5 inch pounds per sq. ft. is applied to the damper jackshaft.
4. Blade Seals: Replaceable, continuous perimeter vinyl seals and jambs with stainless-steel compression-type seals.
5. Bearings: Thrust bearings for vertical blade axles.

H. Integral Smoke Alarm: Smoke detector installed in supply air.

I. DDC Temperature Control: Standalone control module for link between unit controls and DDC temperature-control system. Control module shall be compatible with control system specified in Section 230900 "Instrumentation and Control for HVAC." Links shall include the following:

1. Start/stop interface relay, and relay to notify DDC temperature-control system alarm condition.
2. Hardware interface or additional sensors for the following:

a. Air-distribution static pressure and ventilation-air volumes.

J. Equipment and coil coating. Epoxy polymer coating rated for 6,000-salt spray test according to ASTM B117-90. Luvata or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for 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.

3.2 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. Install separate devices furnished by manufacturer and not factory installed.

D. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

3.3 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.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Inspect units for visible damage.

3. Inspect units for visible damage to fans.
4. Verify that clearances have been provided for servicing.
5. Verify that controls are connected and operable.
6. Verify that filters are installed.
7. Inspect operation of power vents.
8. Inspect and adjust vibration isolators and seismic restraints.
9. Verify bearing lubrication.
10. Clean fans and inspect fan-wheel rotation for movement in correct direction without vibration and binding.
11. Adjust fan belts to proper alignment and tension.
12. Start unit.
13. Inspect and record performance of interlocks and protective devices including response to smoke detectors by fan controls and fire alarm.
14. Operate unit for run-in period.
15. Calibrate controls.
16. Inspect outdoor-air dampers for proper stroke.
17. Verify operational sequence of controls.
18. Measure and record the following airflows. Plot fan volumes on fan curve.

a. Supply-air volume.
b. Outdoor-air flow.

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.

3.5 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 23 74 33

SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.3 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.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Warranty

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.6 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.

1.7 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."

B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.8 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: Five year(s) from date of Substantial Completion.
b. For Parts: Five year(s) from date of Substantial Completion.
c. For Labor: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Daikin.
2. LG
3. Trane
4. Carrier

2.2 INDOOR UNITS (5 TONS (18 kW) OR LESS)

A. Wall-Mounted, Evaporator-Fan Components:

1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 210/240.
3. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
4. Fan: Direct drive, centrifugal.
5. Fan Motors:

a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
b. Multitapped, multispeed with internal thermal protection and permanent lubrication.

c. Enclosure Type: Totally enclosed, fan cooled.
d. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
e. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
7. Condensate Drain Pans:
   a. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on both ends of pan.

2.3 OUTDOOR UNITS (5 TONS (18 kW) OR LESS)

A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

   a. Compressor Type: Scroll.
   b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
   c. Refrigerant Charge: R-410A
   d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 210/240.

3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
4. Fan: Aluminum-propeller type, directly connected to motor.
5. Motor: Permanently lubricated, with integral thermal-overload protection.
6. Low Ambient Kit: Permits operation down to 45 deg F (7 deg C).
7. Mounting Base: Polyethylene.

2.4 ACCESSORIES

A. Control equipment and sequence of operation are specified in Section 230900 "Instrumentation and Control for HVAC" and Section 230993 "Sequence and Operations for HVAC Controls."

B. Thermostat: Low voltage with subbase to control compressor and evaporator fan.

C. Thermostat: Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:

1. Compressor time delay.
2. 24-hour time control of system stop and start.
3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
4. Fan-speed selection including auto setting.

D. Automatic-reset timer to prevent rapid cycling of compressor.

E. 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.

F. Drain Hose: For condensate.

G. Additional Monitoring:

1. Monitor constant and variable motor loads.
2. Monitor variable-frequency-drive operation.
3. Monitor economizer cycle.
4. Monitor cooling load.
5. Monitor air distribution static pressure and ventilation air volumes.

2.5 CAPACITIES AND CHARACTERISTICS

A. Refer to mechanical plans and schedules for capacities and characteristics.

PART 3 - EXECUTION

3.1 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.

3.2 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.

3.3 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.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 238126

SECTION 238413 - HUMIDIFIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following humidifiers:

1. Steam injection.
2. Self-contained.
3. Heated pan.
4. Heat exchanger.

1.3 DEFINITION

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.

1.4 ACTION SUBMITTALS

A. Product Data: 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. Wiring Diagrams: Power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Detail humidifiers and adjacent equipment. Show support locations, type of support, weight on each support, required clearances, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Structural members to which humidifiers will be attached.
2. Size and location of initial access modules for acoustical tile.

B. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For humidifiers to include in operation and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Supply one replacement electrode cylinder with each self-contained humidifier.

1.8 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with ARI 640, "Commercial and Industrial Humidifiers."

1.9 COORDINATION

A. Coordinate location and installation of humidifiers with manifolds in ducts and air-handling units or occupied space. Revise locations and elevations to suit field conditions and to ensure proper humidifier operation.

PART 2 - PRODUCTS

2.1 STEAM-INJECTION HUMIDIFIERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. PURE HUMIDIFIER
2. DRI-STEEM Humidifier Company.

B. Manifold: ASTM A 666, Type 304 stainless steel**, insulated with 1/2-inch (13-mm) fiberglass and stainless-steel jacket; and** extending the full width of duct or plenum with mounting brackets at ends.

C. Discharge Nozzle and Dispersion Fan:

1. Steam-jacketed discharge nozzle, aluminum blade propeller fan with finger guard, and single-speed motor interlocked to operate with humidifier.
2. Fan Mounting: Above and behind discharge outlet on bracket integral to discharge outlet.

D. Steam Separator: **ASTM A 666, Type 304 stainless steel** with **separate** humidifier control valve.

E. Humidifier Control Valve:

1. Actuator: **Electric** modulating with spring return.
2. Actuator: As specified in Section 230900 "Instrumentation and Control for HVAC."

F. Steam Trap: Inverted-bucket type, sized for a minimum of 3 times the maximum rated condensate flow of humidifier at 1/2-psig (3.4-kPa) inlet pressure.

G. Accessories:
1. Duct-mounting, high-limit humidistat.
2. Aquastat mounted on steam condensate return piping to prevent cold operation of humidifier.
3. In-line strainer.
4. Airflow switch for preventing humidifier operation without airflow.

H. Capacities and Characteristics: Refer to mechanical plans and schedules for capacities and characteristics.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine ducts, air-handling units, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before humidifier installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install humidifiers with required clearance for service and maintenance. **Maintain path, downstream from humidifiers, clear of obstructions as required by ASHRAE 62.1.**

B. Seal humidifier manifold duct or plenum penetrations with flange.

C. Install humidifier manifolds in metal ducts and casings constructed according to SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."

D. Install **stainless**-steel drain pan under each manifold mounted in duct.

1. Construct drain pans with connection for drain; insulated **and complying with ASHRAE 62.1**.
2. Connect to condensate trap and drainage piping.
3. Extend drain pan upstream and downstream from manifold a minimum distance recommended by manufacturer but not less than required by ASHRAE 62.1.

E. Install manifold supply piping pitched to drain condensate back to humidifier.

F. Install drip leg upstream from steam trap a minimum of **12 inches (300 mm)** tall for proper operation of trap.

G. Equipment Mounting: Install steam generator on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases specified in **Section 033000 "Cast-in-Place Concrete."**

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct bases to withstand, without damage to equipment, seismic force required by code.
3. Construct concrete bases **4-inch (100-mm)** high and extend base not less than 6 inches (150 mm) in all directions beyond the maximum dimensions of steam generator, unless otherwise indicated or unless required for seismic anchor support.
4. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete floor.
5. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
6. Install anchor bolts to elevations required for proper attachment to supported equipment.

H. Install gas-fired steam generators according to NFPA 54.

3.3 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.
2. Install shutoff valve, strainer, backflow preventer, and union in humidifier makeup line.

B. Install electrical devices and piping specialties furnished by manufacturer but not factory mounted.

C. Install piping from safety relief valves to nearest floor drain.

D. Connect gas piping full size to steam-generator, gas-train inlet with union. Gas piping materials and specialties are specified in **Section 231123 "Facility Natural-Gas Piping."**

E. Connect breeching full size to steam-generator outlet. Venting materials are specified in Section 235100 "Breechings, Chimneys, and Stacks."

F. Connect combustion-air inlet to intake terminal using PVC piping with solvent-cemented joints. Run from boiler connection to outside and terminate adjacent to flue termination.

G. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

H. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

I. Connect humidifier to RO water supply. Refer to plumbing plans for RO water source on roof.

3.4 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. Report results in writing.

B. Perform tests and inspections and prepare test reports.

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.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain humidifiers. Refer to Section 017900 "Demonstration and Training."

END OF SECTION 238413

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.

B. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN/THWN-2.

2.2 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SYSTEM DESCRIPTION

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 NFPA 70.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger, except VFC cable, which shall be extra flexible stranded.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.

B. Feeders Concealed in Ceilings, Walls and Partitions: Type THHN/THWN-2, single conductors in raceway.

C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

D. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway OR Metal-clad cable, Type MC. The use of metal clad cable (MC) shall be permitted only for wiring to individual wiring devices or light fixtures with 12 AWG conductors, but not for branch circuit homeruns.

E. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway OR Metal-clad cable, Type MC. The use of metal clad cable (MC) shall be permitted only for wiring to individual wiring devices or light fixtures with 12 AWG conductors, but not for branch circuit homeruns.

F. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.

    a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
    b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
    c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

B. Test and Inspection Reports: Prepare a written report to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

C. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes grounding and bonding systems and equipment.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Burndy; Part of Hubbell Electrical Systems.
2. ERICO International Corporation.
3. Thomas & Betts Corporation; A Member of the ABB Group.

2.2 SYSTEM DESCRIPTION

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 UL 467 for grounding and bonding materials and equipment.

2.3 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.4 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.5 GROUNDING ELECTRODES

A. Verify entirety of existing grounding electrode. If value is higher than 25 Ohms add ground Rod as required. Ground rods shall be Copper-clad steel, sectional type; 3/4 inch by 10 feet.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install bare tinned-copper conductor, AWG minimum.

1. Bury at least 24 inches below grade.

C. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.

6. Flexible raceway runs.
7. Armored and metal-clad cable runs.
8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

E. Metallic Fences: Comply with requirements of IEEE C2.

1. Grounding Conductor: Bare, tinned copper, not less than No. 8 AWG.
2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
3. Barbed Wire: Strands shall be bonded to the grounding conductor.

3.4 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
2. Test Wells: Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

E. Grounding and Bonding for Piping:

1. Verify that Metal Water Service Pipe is bounded to existing grounding electrode system. If such pipe is not bounded install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

2. Verify that Water Meter Piping is bounded to existing grounding electrode system. If such piping system is not bounded use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.

C. Delegated-Design Submittal: For hangers and supports for electrical systems.

1. Include design calculations and details of trapeze hangers.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, and coordinated with each other, using input from installers of the items involved:

B. Seismic Qualification Certificates: For hangers and supports for electrical equipment and systems, accessories, and components, from manufacturer.

C. Welding certificates.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design hanger and support system.

B. Seismic Performance: Hangers and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the supported equipment and systems will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."
2. Component Importance Factor: 1.5.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4 factory-fabricated components for field assembly.

1. Material: Pre-galvanized steel.
2. Channel Width: 1-5/8 inches.
3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
5. Channel Dimensions: Selected for applicable load criteria.

B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.

E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems unless requirements in this Section are stricter.

B. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMTs, IMCs, and RMCs as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

D. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

E. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.

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.

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 PAINTING

A. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Surface raceways.
5. Boxes, enclosures, and cabinets.

1.2 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. GRC: Comply with ANSI C80.1 and UL 6.

C. ARC: Comply with ANSI C80.5 and UL 6A.

D. IMC: Comply with ANSI C80.6 and UL 1242.

E. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch, minimum.

F. EMT: Comply with ANSI C80.3 and UL 797.

G. FMC: Comply with UL 1; zinc-coated steel.

H. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

I. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
2. Fittings for EMT:

a. Material: Steel.
b. Type: Setscrew.

3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

J. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

A. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ENT: Comply with NEMA TC 13 and UL 1653.

C. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

D. LFNC: Comply with UL 1660.

E. Continuous HDPE: Comply with UL 651B.

F. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D 3485.

G. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

H. Fittings for LFNC: Comply with UL 514B.

I. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

J. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

2.4 SURFACE RACEWAYS

A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5.

C. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.

2.5 BOXES, ENCLOSURES, AND CABINETS

A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

D. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

E. Metal Floor Boxes:

1. Material: Cast metal or sheet metal.
2. Type: Fully adjustable.
3. Shape: Rectangular.
4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Nonmetallic Floor Boxes: Nonadjustable, round or rectangular.

1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.

H. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb.

1. Listing and labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

I. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

J. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

K. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

L. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.

M. Gangable boxes are allowed.

N. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic.
3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

O. Cabinets:

1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Indoors: Apply raceway products as specified below unless otherwise indicated.

1. Exposed, Not Subject to Physical Damage: EMT or RNC.
2. Exposed, Not Subject to Severe Physical Damage: EMT or RNC identified for such use.
3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:

a. Loading dock.
b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
c. Mechanical rooms.

4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: GRC.
7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

B. Minimum Raceway Size: 1/2-inch trade size.

C. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.

2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

D. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

E. Install surface raceways only where indicated on Drawings.

F. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

D. Arrange stub-ups so curved portions of bends are not visible above finished slab.

E. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.

F. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

G. Support conduit within 12 inchesof enclosures to which attached.

H. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Arrange raceways to keep a minimum of 1 inch of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
5. Change from ENT to RNC, Type EPC-40-PVC, before rising above floor.

I. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

J. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

K. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

L. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

N. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

O. Surface Raceways:

1. Install surface raceway with a minimum 2-inchradius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

P. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces.

Q. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Where otherwise required by NFPA 70.

R. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

    a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
    b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
    d. Attics: 135 deg F temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per degree F of temperature change for PVC conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

S. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semi-recessed luminaires, and equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

T. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

U. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between the box and cover plate or the supported equipment and box.

V. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

W. Locate boxes so that cover or plate will not span different building finishes.

X. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

Y. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

Z. Set metal floor boxes level and flush with finished floor surface.

AA. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Section 312000 "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
4. Install manufactured duct elbows for stub-up at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
    b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

6. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.5 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.6 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. LEED Submittals:

1. Product Data for Credit EQ 4.1: For sealants, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit EQ 4: For sealants, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.
2. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Advance Products & Systems, Inc.
b. CALPICO, Inc.
c. Metraflex Company (The).
d. Pipeline Seal and Insulator, Inc.
e. Proco Products, Inc.

2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon steel.
4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. HOLDRITE.

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

2. Sealant shall have VOC content of g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

   a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
   b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 260544

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels, including arc-flash warning labels.
8. Miscellaneous identification products.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

B. Warning labels and signs shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.3 LABELS

A. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Brady Corporation.
b. Champion America.
c. Marking Services, Inc.
d. Panduit Corp.

B. Self-Adhesive Labels:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Brady Corporation.
b. emedco.
c. Panduit Corp.

2. Preprinted, 3-mil-thick, vinyl flexible label with acrylic pressure-sensitive adhesive.
3. Vinyl, thermal, transfer-printed, 3-mil-thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

a. Nominal Size: 3.5-by-5-inch.

2.4 TAPES AND STENCILS:

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Carlton Industries, LP.
b. Champion America.
c. Marking Services, Inc.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Brady Corporation.
b. Carlton Industries, LP.
c. emedco.

C. Floor Marking Tape: 2-inch-wide, 5-mil pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Carlton Industries, LP.
b. Seton Identification Products.

2.5 Tags

A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Brady Corporation.
b. Carlton Industries, LP.
c. emedco.
d. Marking Services, Inc.
e. Seton Identification Products.

B. Nonmetallic Preprinted Tags: Polyethylene tags, 0.015 inch thick, color-coded for phase and voltage level, with factory printed permanent designations; punched for use with self-locking cable tie fastener.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Brady Corporation.
b. Carlton Industries, LP.
c. emedco.
d. Grafoplast Wire Markers.
e. LEM Products Inc.
f. Panduit Corp.
g. Seton Identification Products.

C. Write-On Tags:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Carlton Industries, LP.
b. LEM Products Inc.
c. Seton Identification Products.

2. Polyester Tags: 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment to raceway, conductor, or cable.
3. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
4. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.6 Signs

A. Baked-Enamel Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal Size: 7 by 10 inches.
4. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Carlton Industries, LP.
b. Champion America.
c. emedco.

B. Metal-Backed Butyrate Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch galvanized-steel backing and with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal Size: 10 by 14 inches.
4. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Brady Corporation.
b. Champion America.
c. emedco.

C. Laminated Acrylic or Melamine Plastic Signs:

1. Engraved legend.
2. Thickness:

a. For signs up to 20 sq. inches, minimum 1/16-inch-.
b. For signs larger than 20 sq. inches, 1/8 inch thick.
c. Engraved legend with black letters on white face.
d. Punched or drilled for mechanical fasteners.
e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

3. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Brady Corporation.
b. Carlton Industries, LP.
c. emedco.

2.7 CABLE TIES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. HellermannTyton.
2. Ideal Industries, Inc.
3. Marking Services, Inc.
4. Panduit Corp.

B. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F according to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black, except where used for color-coding.

C. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F according to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.

4. Color: Black.

D. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, self-locking.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F according to ASTM D 638: 7000 psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Apply identification devices to surfaces that require finish after completing finish work.

C. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.

D. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

E. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive vinyl label. Install labels at 10-foot maximum intervals.

B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels containing the wiring system legend and system voltage. System legends shall be as follows:

1. "EMERGENCY POWER."
2. "POWER."
3. "UPS."

C. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive vinyl labels with the conductor or cable designation, origin, and destination.

D. Control-Circuit Conductor Termination Identification: For identification at terminations, provide heat-shrink preprinted tubes or self-adhesive vinyl labels with the conductor designation.

E. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.

F. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker-tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

G. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.

1. Limit use of underground-line warning tape to direct-buried cables.
2. Install underground-line warning tape for direct-buried cables and cables in raceways.

H. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

I. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.

1. Comply with 29 CFR 1910.145.
2. Identify system voltage with black letters on an orange background.
3. Apply to exterior of door, cover, or other access.
4. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:

a. Power-transfer switches.
b. Controls with external control power connections.

J. Arc Flash Warning Labeling: Self-adhesive thermal transfer vinyl labels.

1. Comply with NFPA 70E, ANSI Z535.4 and with IEEE 1584.

K. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

L. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.

M. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.

1. Labeling Instructions:

a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine plastic label. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.
b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.

d. Unless labels are provided with self-adhesive means of attachment, fasten them with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

END OF SECTION 260553

SECTION 260572 - OVERCURRENT PROTECTIVE DEVICE SHORT-CIRCUIT STUDY

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes a computer-based, fault-current study to determine the minimum interrupting capacity of circuit protective devices.

1.2 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.

1. Short-circuit study input data, including completed computer program input data sheets.
2. Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.

a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.
b. Revised single-line diagram, reflecting field investigation results and results of short-circuit study.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Field Adjusting Agency.

B. Product Certificates: For short-circuit study software, certifying compliance with IEEE 399.

1.4 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Short-Circuit Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Short-Circuit Study Specialist Qualifications: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational

Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Power Analytics, Corporation.
2. SKM Systems Analysis, Inc.

B. Comply with IEEE 399 and IEEE 551.

C. Analytical features of fault-current-study computer software program shall have the capability to calculate mandatory features as listed in IEEE 399.

2.2 SHORT-CIRCUIT STUDY REPORT CONTENTS

A. Executive summary.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of the computer printout.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, and panelboard designations.

D. Comments and recommendations for system improvements, where needed.

E. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short-circuit ratings.
2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.

F. Short-Circuit Study Input Data: As described in "Power System Data" Article in the Evaluations.

G. Short-Circuit Study Output:

1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a. Voltage.
b. Calculated fault-current magnitude and angle.
c. Fault-point X/R ratio.

d. Equivalent impedance.

2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

   a. Voltage.
   b. Calculated symmetrical fault-current magnitude and angle.
   c. Fault-point X/R ratio.
   d. Calculated asymmetrical fault currents:

      1) Based on fault-point X/R ratio.
      2) Based on calculated symmetrical value multiplied by 1.6.
      3) Based on calculated symmetrical value multiplied by 2.7.

3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

   a. Voltage.
   b. Calculated symmetrical fault-current magnitude and angle.
   c. Fault-point X/R ratio.
   d. No AC Decrement (NACD) ratio.
   e. Equivalent impedance.
   f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
   g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Obtain all data necessary for the conduct of the study.

1. Verify completeness of data supplied on the one-line diagram. Call any discrepancies to the attention of Architect.
2. For equipment provided that is Work of this Project, use characteristics submitted under the provisions of action submittals and information submittals for this Project.

B. Gather and tabulate the following input data to support the short-circuit study:

1. Product Data for Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Obtain electrical power utility impedance at the service.
3. Power sources and ties.
4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
5. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
7. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
8. Motor horsepower and NEMA MG 1 code letter designation.
9. Cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

3.2 SHORT-CIRCUIT STUDY

A. Perform study following the general study procedures contained in IEEE 399.

B. Calculate short-circuit currents according to IEEE 551.

C. Base study on the device characteristics supplied by device manufacturer.

D. The extent of the electrical power system to be studied is indicated on Drawings.

E. Begin short-circuit current analysis at the service, extending down to the system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 10 kA or less.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. The calculations shall include the ac fault-current decay from induction motors. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.

1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each of the following:

1. Electric utility's supply termination point.
2. Incoming switchgear.
3. Low-voltage switchgear.
4. Motor-control centers.
5. Control panels.
6. Automatic transfer switches.
7. Branch circuit panelboards.
8. Disconnect switches.
9. VFD’s.

3.3 ADJUSTING

A. Make minor modifications to equipment as required to accomplish compliance with short-circuit study.

3.4 DEMONSTRATION

A. Train Owner's operating and maintenance personnel in the use of study results.

END OF SECTION 260572

SECTION 260573 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.

1.2 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.

1. Coordination-study input data, including completed computer program input data sheets.
2. Study and equipment evaluation reports.
3. Overcurrent protective device coordination study report; signed, dated, and sealed by a qualified professional engineer.

a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Field Adjusting Agency.

B. Product Certificates: For overcurrent protective device coordination study software, certifying compliance with IEEE 399.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For the overcurrent protective devices to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. The following parts from the Protective Device Coordination Study Report:

1) One-line diagram.
2) Protective device coordination study.
3) Time-current coordination curves.

b. Power system data.

1.5 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Coordination Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Coordination Study Specialist Qualifications: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Software Developers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Power Analytics, Corporation.
b. SKM Systems Analysis, Inc.

B. Comply with IEEE 242 and IEEE 399.

C. Analytical features of device coordination study computer software program shall have the capability to calculate mandatory features as listed in IEEE 399.

2.2 PROTECTIVE DEVICE COORDINATION STUDY REPORT CONTENTS

A. Executive summary.

B. Study descriptions, purpose, basis and scope. Include case descriptions, definition of terms and guide for interpretation of the computer printout.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, and panelboard designations.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output: As specified in "Short Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260572 "Overcurrent Protective Device Short-Circuit Study."

F. Protective Device Coordination Study:

1. Report recommended settings of protective devices, ready to be applied in the field. Use manufacturer's data sheets for recording the recommended setting of overcurrent protective devices when available.

a. Phase and Ground Relays:

1) Device tag.
2) Relay current transformer ratio and tap, time dial, and instantaneous pickup value.
3) Recommendations on improved relaying systems, if applicable.

b. Circuit Breakers:

1) Adjustable pickups and time delays (long time, short time, ground).
2) Adjustable time-current characteristic.
3) Adjustable instantaneous pickup.
4) Recommendations on improved trip systems, if applicable.

c. Fuses: Show current rating, voltage, and class.

G. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:

1. Device tag and title, one-line diagram with legend identifying the portion of the system covered.
2. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
3. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
4. Plot the following listed characteristic curves, as applicable:

a. Power utility's overcurrent protective device.
b. Low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
c. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
d. Transformer full-load current, magnetizing inrush current.
e. Ground-fault protective devices.
f. The largest feeder circuit breaker in each motor-control center and panelboard.

5. Provide adequate time margins between device characteristics such that selective operation is achieved.
6. Comments and recommendations for system improvements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.

1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 PROTECTIVE DEVICE COORDINATION STUDY

A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.

B. Comply with IEEE 399 for general study procedures.

C. The study shall be based on the device characteristics supplied by device manufacturer.

D. The extent of the electrical power system to be studied is indicated on Drawings.

E. Begin analysis at the service, extending down to the system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 10 kA or less.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. The calculations shall include the ac fault-current decay from induction motors. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.

1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and single line-to-ground fault at each of the following:

1. Electric utility's supply termination point.
2. Switchgear.
3. Low-voltage switchgear.
4. Motor-control centers.
5. Standby generators and automatic transfer switches.
6. Branch circuit panelboards.
7. VFD’s.

I. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short-circuit ratings.
2. Adequacy of switchgear, motor-control centers, and panelboard bus bars to withstand short-circuit stresses.

3.3 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the overcurrent protective device study.

1. Verify completeness of data supplied in the one-line diagram on Drawings. Call discrepancies to the attention of Architect.
2. Use characteristics submitted under the provisions of action submittals and information submittals for this Project.

B. Gather and tabulate the following input data to support coordination study. The list below is a guide.

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Electrical power utility impedance at the service.
3. Power sources and ties.
4. Short-circuit current at each system bus, three phase and line-to-ground.
5. Full-load current of all loads.
6. Voltage level at each bus.
7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
8. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
9. Maximum demands from service meters.
10. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
11. Motor horsepower and NEMA MG 1 code letter designation.
12. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
13. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:

    a. Special load considerations, including starting inrush currents and frequent starting and stopping.
    b. Ratings, types, and settings of utility company's overcurrent protective devices.
    c. Special overcurrent protective device settings or types stipulated by utility company.
    d. Time-current-characteristic curves of devices indicated to be coordinated.
    e. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
    f. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
    g. Panelboards, switchboards, motor-control center ampacity, and SCCR in amperes rms symmetrical.

3.4 FIELD ADJUSTING

A. Adjust relay and protective device settings according to the recommended settings provided by the coordination study. Field adjustments shall be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

B. Make minor modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.

C. Testing and adjusting shall be by a full-time employee of the Field Adjusting Agency, who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters. Perform NETA tests and inspections for all adjustable overcurrent protective devices.

3.5 DEMONSTRATION

A. Engage the Coordination Study Specialist to train Owner's maintenance personnel in the following:

1. Acquaint personnel in the fundamentals of operating the power system in normal and emergency modes.

2. Hand-out and explain the objectives of the coordination study, study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpreting the time-current coordination curves.
3. Adjust, operate, and maintain overcurrent protective device settings.

END OF SECTION 260573

SECTION 260574 - OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

1.2 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals shall be in digital form.

1. Arc-flash study input data, including completed computer program input data sheets.
2. Arc-flash study report; signed, dated, and sealed by a qualified professional engineer.

a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For .

B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance procedures according to requirements in NFPA 70E shall be provided in the equipment manuals.

B. Operation and Maintenance Procedures: In addition to items specified in Section 017823 "Operation and Maintenance Data," provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

1.5 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Arc-Flash Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Arc-Flash Study Specialist Qualifications: Professional engineer in charge of performing the study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Software Developers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Power Analytics, Corporation.
b. SKM Systems Analysis, Inc.

B. Comply with IEEE 1584 and NFPA 70E.

C. Analytical features of device coordination study computer software program shall have the capability to calculate mandatory features as listed in IEEE 399.

2.2 ARC-FLASH STUDY REPORT CONTENT

A. Executive summary.

B. Study descriptions, purpose, basis and scope.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center and panelboard designations.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output: As specified in "Short-Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260572 "Overcurrent Protective Device Short-Circuit Study."

F. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 260573 "Overcurrent Protective Device Coordination Study."

G. Arc-Flash Study Output:

1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

    a. Voltage.
    b. Calculated symmetrical fault-current magnitude and angle.
    c. Fault-point X/R ratio.
    d. No AC Decrement (NACD) ratio.
    e. Equivalent impedance.
    f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
    g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

H. Incident Energy and Flash Protection Boundary Calculations:

1. Arcing fault magnitude.
2. Protective device clearing time.
3. Duration of arc.
4. Arc-flash boundary.
5. Working distance.
6. Incident energy.
7. Hazard risk category.
8. Recommendations for arc-flash energy reduction.

I. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.2 ARC-FLASH HAZARD ANALYSIS

A. Comply with NFPA 70E and its Annex D for hazard analysis study.

B. Preparatory Studies:

1. Short-Circuit Study Output: As specified in "Short-Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260572 "Overcurrent Protective Device Short-Circuit Study."
2. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 260573 "Overcurrent Protective Device Coordination Study."

C. Calculate maximum and minimum contributions of fault-current size.

1. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume no motor load.
2. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

D. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.

E. Include low-voltage equipment locations, except equipment rated 240-V ac or less fed from transformers less than 125 kVA.

F. Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.

G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors shall be decremented as follows:

1. Fault contribution from induction motors should not be considered beyond three to five cycles.

H. Arc-flash computation shall include both line and load side of a circuit breaker as follows:

1. When the circuit breaker is in a separate enclosure.
2. When the line terminals of the circuit breaker are separate from the work location.

I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.3 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the arc-flash hazard analysis.

1. Verify completeness of data supplied on the one-line diagram on Drawings and under "Preparatory Studies" Paragraph in "Arc-Flash Hazard Analysis" Article. Call discrepancies to the attention of Architect.
2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.

B. Electrical Survey Data: Gather and tabulate the following input data to support study.

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Obtain electrical power utility impedance at the service.
3. Power sources and ties.
4. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
5. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
6. Motor horsepower and NEMA MG 1 code letter designation.
7. Low-voltage cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

3.4 DEMONSTRATION

A. Engage the Arc-Flash Study Specialist to train Owner's maintenance personnel in the potential arc-flash hazards associated with working on energized equipment and the significance of the arc-flash warning labels.

END OF SECTION 260574

SECTION 260913 - ELECTRICAL POWER MONITORING AND CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes PC-based computer and software for monitoring and control of electrical power system.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1. Attach copies of approved Product Data submittals for products (such as switchboards and switchgear) that describe power monitoring and control features to illustrate coordination among related equipment and power monitoring and control.

B. Shop Drawings: For power monitoring and control equipment. Include plans, elevations, sections, details, and attachments to other work.

1. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components.
2. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Other Informational Submittals: System installation and setup guides, with data forms to plan and record options and setup decisions.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data:

1. Operating and applications software documentation.
2. Software licenses.
3. Hard copies of manufacturer's specification sheets, operating specifications, design guides, user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy submittal.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Software Backup: On a magnetic media or compact disc, complete with Owner-selected options.
3. Device address list and the set point of each device and operator option, as set in applications software.

C. Software Upgrade Kit: For Owner to use in modifying software to suit future power system revisions or power monitoring and control revisions.

D. Software licenses and upgrades required by and installed for operating and programming digital and analog devices.

1.5 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.

1.6 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support for two years.

B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include the operating systems. Upgrade shall include new or revised licenses for use of software.

1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Eaton.
2. Schneider Electric USA, Inc.

2.2 FUNCTIONAL DESCRIPTION

A. Instrumentation and Recording Devices: Monitor and record load profiles and chart energy consumption patterns.

1. Calculate and Record the Following:

a. Load factor.
b. Peak demand periods.

2. Measure and Record Metering Data for the Following:

a. Electricity.
b. Domestic water.
c. Natural gas.
d. Water
e. Others as called out in Measurement and Verification plan.

B. Software: Calculate allocation of utility costs.

1. Automatically Import Energy Usage Records to Allocate Energy Costs for the Following:

a. At least 15 departments.
b. At least 30 tenants.
c. At least five processes.
d. At least five buildings.

C. Power Quality Monitoring: Identify power system anomalies and measure, display, and record trends and alarms of the following power quality parameters:

1. Voltage regulation and unbalance.
2. Continuous three-phase rms voltage.
3. Periodic max./min./avg. voltage samples.
4. Harmonics.
5. Voltage excursions.
6. Others as called out in Measurement and Verification plan.

2.3 SYSTEM REQUIREMENTS

A. Surge Protection: For external wiring of each conductor entry connection to components to protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads.

1. Minimum Protection for Power Lines 120 V and More: Auxiliary panel suppressors complying with requirements in Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits."

2.4 OPERATING SYSTEM

A. Software: Configured to run on a portable laptop computer, a single PC, or a palm computer, with capability for accessing a single meter at a time.

2.5 APPLICATIONS SOFTWARE

A. Basic Requirements:

1. Fully compatible with and based on the approved operating system.
2. Password-protected operator login and access; three levels, minimum.
3. Password-protected setup functions.
4. Context-sensitive online help.
5. Capability of creating, deleting, and copying files; and automatically maintaining a directory of all files, including size and location of each sequential and random-ordered record.
6. Automatic and encrypted backups for database and history; automatically stored at selected workstation, local or remote as indicated by owner and encrypted per owner’s security requirements, which must be used to restore or read data contained in backup.
7. Operator audit trail for recording and reporting all changes made to user-defined system options.

B. Data Formats:

1. User-programmable export and import of data to and from commonly used Microsoft Windows spreadsheet, database, billing, and other applications; using dynamic data exchange technology.
2. Option to convert reports and graphics to HTML format.

C. Metered Data: Display metered values in real time.

D. Remote Control:

1. Display circuit-breaker status and allow breaker control.
2. User defined with load-shedding automatically initiated and executed schemes responding to programmed time schedules, set points of metered demands, utility contracted load shedding, or combinations of these.

E. Waveform Data: Display and record waveforms on demand or automatically on an alarm or programmed event. Include the graphic displays of the following, based on user-specified criteria:

1. Phase voltages, phase currents, and residual current.
2. Waveforms ranging in length from 2 cycles to 5 minutes.
3. Disturbance and steady-state waveforms up to 512 points per cycle.
4. Calculated waveform, based on recorded data, on a minimum of four cycles of data of the following:

    a. THD.
    b. rms magnitudes.
    c. Peak values.
    d. Crest factors.
    e. Magnitude of individual harmonics.

F. Data Sharing: Allow export of recorded displays and tabular data to third-party applications software.

1. Tabular data shall be in the comma-separated values.

G. Activity Billing Software:

1. Automatically compute and prepare activity demand and energy-use statements based on metering of energy use and peak demand integrated over user-defined interval.
2. Intervals shall be same as used by electric utilities, including current vendor.
3. Import metered data from saved records that were generated by metering and monitoring software.
4. Maintain separate directory for each activity's historical billing information.
5. Prepare summary reports in user-defined formats and time intervals.

H. Reporting: User commands initiate the reporting of a list of current alarm, supervisory, and trouble conditions in system or a log of past events.

1. Print a record of user-defined alarm, supervisory, and trouble events on workstation printer.
2. Sort and report by device name and by function.
3. Report type of signal (alarm, supervisory, or trouble), description, date, and time of occurrence.
4. Differentiate alarm signals from other indications.
5. When system is reset, report reset event with same information concerning device, location, date, and time.

2.6 COMMUNICATION COMPONENTS AND NETWORKS

A. Network Configuration: High-speed, multi-access, open nonproprietary, industry standard communication protocol; LANs complying with EIA 485, 100 Base-T Ethernet, and Modbus TCP/IP.

2.7 POWER MONITORS

A. Separately mounted, permanently installed instrument for power monitoring and control, complying with UL 1244.

1. Enclosure: NEMA 250, Type 1.

B. Environmental Conditions: System components shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Indoor installation in non-air-conditioned spaces that have environmental controls to maintain ambient conditions of 0 to 122 deg F dry bulb and 20 to 90 percent relative humidity, noncondensing.

C. rms Real-Time Measurements:

1. Current: Each phase, neutral, average of three phases, percent unbalance.

2. Voltage: Line-to-line each phase, line-to-line average of three phases, line-to-neutral each phase, line-to-neutral average of three phases, line-to-neutral percent unbalance.
3. Power: Per phase and three-phase total.
4. Reactive Power: Per phase and three-phase total.
5. Power Factor: Per phase and three-phase total.
6. Frequency.
7. THD: Current and voltage.
8. Accumulated Energy: Real kWh, reactive kVARh, apparent kVAh (signed/absolute).
9. Incremental Energy: Real kWh, reactive kVARh, apparent kVAh (signed/absolute).
10. Conditional Energy: Real kWh, reactive kVARh, apparent kVAh (signed/absolute).

D. Demand Current Calculations, per Phase, Three-Phase Average and Neutral:

1. Present.
2. Running average.
3. Last completed interval.
4. Peak.

E. Demand Real Power Calculations, Three-Phase Total:

1. Present.
2. Running average.
3. Last completed interval.
4. Predicted.
5. Peak.
6. Coincident with peak kVA demand.
7. Coincident with kVAR demand.

F. Demand Reactive Power Calculations, Three-Phase Total:

1. Present.
2. Running average.
3. Last completed interval.
4. Predicted.
5. Peak.
6. Coincident with peak kVA demand.
7. Coincident with kVAR demand.

G. Average Power Factor Calculations, Demand Coincident, Three-Phase Total:

1. Last completed interval.
2. Coincident with kW peak.
3. Coincident with kVAR peak.
4. Coincident with kVA peak.

H. Power Demand Calculations: According to one of the following calculation methods, selectable by the user:

1. Thermal Demand: Sliding window updated every second for the present demand and at end of the interval for the last interval. Adjustable window that can be set in 1-minute intervals, from 1 to 60 minutes.
2. Block Interval with Optional Subintervals: Adjustable for 1-minute intervals, from 1 to 60 minutes. User-defined parameters for the following block intervals:

    a. Sliding block that calculates demand every second, with intervals less than 15 minutes, and every 15 seconds with an interval between 15 and 60 minutes.
    b. Fixed block that calculates demand at end of the interval.
    c. Rolling block subinterval that calculates demand at end of each subinterval and displays it at end of the interval.

3. Demand Calculation Initiated by a Synchronization Signal:

    a. Signal is a pulse from an external source. Demand period begins with every pulse. Calculation shall be configurable as either a block or rolling block calculation.
    b. Signal is a communication signal. Calculation shall be configurable as either a block or rolling block calculation.

I. Sampling:

1. Current and voltage shall be digitally sampled at a rate high enough to provide accuracy to 63rd harmonic of 60-Hz fundamental.
2. Power monitor shall provide continuous sampling at a rate of 128 samples per cycle on all voltage and current channels in the meter.

J. Minimum and Maximum Values: Record monthly minimum and maximum values, including date and time of record. For three-phase measurements, identify phase of recorded value. Record the following parameters:

1. Line-to-line voltage.
2. Line-to-neutral voltage.
3. Current per phase.
4. Line-to-line voltage unbalance.
5. Line-to-neutral voltage unbalance.
6. Power factor.
7. Displacement power factor.
8. Total power.
9. Total reactive power.
10. THD voltage L-L.
11. THD voltage L-N.
12. THD current.
13. Frequency.

K. Harmonic Calculation: Display and record the following:

1. Harmonic magnitudes and angles for each phase voltage and current through 31st harmonic. Calculate for all three phases, current and voltage, and residual current. Current and voltage information for all phases shall be obtained simultaneously from same cycle.
2. Harmonic magnitude reported as a percentage of the fundamental or as a percentage of rms values, as selected by user.

L. Current and Voltage Ratings:

1. Designed for use with current inputs from standard instrument current transformers with 5-A secondary and shall have a metering range of 0-10 A.
2. Withstand ratings shall not be less than 15 A, continuous; 50 A, lasting over 10 seconds, no more frequently than once per hour; 500 A, lasting 1 second, no more frequently than once per hour.
3. Designed for use with voltage inputs from standard instrument potential transformers with a 120-V secondary.

M. Accuracy at full-scale for meters that are circuit-breaker accessories shall not be less than the following:

1. Current: Plus or minus 2.5 percent.
2. Voltage: Plus or minus 1.5 percent.
3. Energy, Demand, and Power: Plus or minus 4.0 percent.
4. Frequency: Plus or minus 1 Hz.

N. Waveform Capture:

1. Capture and store steady-state waveforms of voltage and current channels; initiated manually. Each capture shall be for 3 cycles, 128 data points for each cycle, allowing resolution of harmonics to 31st harmonic of basic 60 Hz.
2. Store captured waveforms in internal nonvolatile memory; available for PC display, archiving, and analysis.

O. Input: One digital input signal(s).

1. Normal mode for on/off signal.
2. Demand interval synchronization pulse, accepting a demand synchronization pulse from a utility demand meter.
3. Conditional energy signal to control conditional energy accumulation.

P. Outputs:

1. Operated either by user command sent via communication link, or set to operate in response to user-defined alarm or event.
2. Closed in either a momentary or latched mode as defined by user.
3. Each output relay used in a momentary contact mode shall have an independent timer that can be set by user.
4. One digital KY pulse to a user-definable increment of energy measurement. Output ratings shall be up to 120-V ac, 300-V dc, 50 mA, and provide 3500-V rms isolation.
5. One relay output module(s), providing a load voltage range from 20- to 240-V ac or from 20- to 30-V dc, supporting a load current of 2 A.
6. Output Relay Control:

    a. Relay outputs shall operate either by user command sent via communication link or in response to user-defined alarm or event.
    b. Normally open and normally closed contacts, field configured to operate as follows:

        1) Normal contact closure where contacts change state for as long as signal exists.
        2) Latched mode when contacts change state on receipts of a pickup signal; changed state is held until a dropout signal is received.
        3) Timed mode when contacts change state on receipt of a pickup signal; changed state is held for a preprogrammed duration.
        4) End of power demand interval when relay operates as synchronization pulse for other devices.
        5) Energy Pulse Output: Relay pulses quantities used for absolute kWh, absolute kVARh, kVAh, kWh In, kVARh In, kWh Out, and kVARh Out.
        6) Output controlled by multiple alarms using Boolean-type logic.

Q. Onboard Data Logging:

1. Store logged data, alarms, events, and waveforms in 80 KB of onboard nonvolatile memory.
2. Stored Data:

    a. Billing Log: User configurable; data shall be recorded every 15 minutes, identified by month, day, and 15-minute interval. Accumulate 24 months of monthly data, 32 days of daily data, and between 2 and 52 days of 15-minute interval data, depending on number of quantities selected.
    b. Alarm Log: Include time, date, event information, and coincident information for each defined alarm or event.
    c. Waveform Log: Store captured waveforms configured as "fill-and-hold" or "circular, first-in first-out."

3. Default values for all logs shall be initially set at factory, with logging to begin on device power up.

R. Alarms.

1. User Options:

a. Define pickup, dropout, and delay.
b. Assign one of four severity levels to make it easier for user to respond to the most important events first.
c. Allow for combining up to four alarms using Boolean-type logic statements for outputting a single alarm.

2. Alarm Events:

a. Over/undercurrent.
b. Over/undervoltage.
c. Current imbalance.
d. Phase loss, current.
e. Phase loss, voltage.
f. Voltage imbalance.
g. Over kW demand.
h. Phase reversal.
i. Digital input off/on.
j. End of incremental energy interval.
k. End of demand interval.

S. Control Power: 90- to 457-V ac or 100- to 300-V dc.

T. Communications: Local plug-in connections shall be for RS-232 and 100 Base-T Ethernet.

U. Display Monitor:

1. Backlighted LCD to display metered data with touch-pad selecting device.
2. Touch-screen display shall be a minimum 12-inch diagonal, resolution of 800 by 600 RGB pixels, 256 colors; NEMA 250, Type 1 display enclosure.
3. Display four values on one screen at same time.

a. Current, per phase rms, three-phase average and neutral.
b. Voltage, phase to phase, phase to neutral, and three-phase averages of phase to phase and phase to neutral.
c. Real power, per phase and three-phase total.
d. Reactive power, per phase and three-phase total.
e. Apparent power, per phase and three-phase total.
f. Power factor, per phase and three-phase total.
g. Frequency.
h. Demand current, per phase and three-phase average.
i. Demand real power, three-phase total.
j. Accumulated energy (MWh and MVARh).
k. THD, current and voltage, per phase.

4. Reset: Allow reset of the following parameters at the display:

a. Peak demand current.
b. Peak demand power (kW) and peak demand apparent power (kVA).
c. Energy (MWh) and reactive energy (MVARh).

2.8 LOW-VOLTAGE WIRING

A. Comply with Section 260523 "Control-Voltage Electrical Power Cables."

B. Low-Voltage Control Cable: Multiple conductor, color-coded, No. 20 AWG copper, minimum.

1. Sheath: PVC; except in plenum-type spaces, use sheath listed for plenums.
2. Ordinary Switching Circuits: Three conductors unless otherwise indicated.

3. Switching Circuits with Pilot Lights or Locator Feature: Five conductors unless otherwise indicated.

PART 3 - EXECUTION

3.1 CABLING

A. Comply with NECA 1.

B. Install cables and wiring according to requirements in Section 271500 "Communications Horizontal Cabling."

C. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters. Conceal raceway and wiring except in unfinished spaces.

3.2 IDENTIFICATION

A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."

B. Label each power monitoring and control module with a unique designation.

3.3 GROUNDING

A. Comply with IEEE 1100, "Recommended Practice for Powering and Grounding Electronic Equipment."

3.4 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. Electrical Tests: Use caution when testing devices containing solid-state components.
2. Continuity tests of circuits.
3. Operational Tests: Set and operate controls at workstation and at monitored and controlled devices to demonstrate their functions and capabilities. Use a methodical sequence that cues and reproduces actual operating functions as recommended by manufacturer. Submit sequences for approval. Note response to each test command and operation. Note time intervals between initiation of alarm conditions and registration of alarms at central-processing workstation.

    a. Coordinate testing required by this Section with that required by Sections specifying equipment being monitored and controlled.
    b. Test LANs according to requirements in Section 271500 "Communications Horizontal Cabling."
    c. System components with battery backup shall be operated on battery power for a period of not less than 10 percent of calculated battery operating time.
    d. Verify accuracy of graphic screens and icons.
    e. Metering Test: Load feeders, measure loads on feeder conductor with an rms reading clamp-on ammeter, and simultaneously read indicated current on the same phase at

central-processing workstation. Record and compare values measured at the two locations. Resolve discrepancies greater than 5 percent and record resolution method and results.

f. Record metered values, control settings, operations, cues, time intervals, and functional observations and submit test reports printed by workstation printer.

C. Correct deficiencies, make necessary adjustments, and retest. Verify that specified requirements are met.

D. Test Labeling: After satisfactory completion of tests and inspections, apply a label to tested components indicating test results, date, and responsible agency and representative.

E. Reports: Written reports of tests and observations. Record defective materials and workmanship and unsatisfactory test results. Record repairs and adjustments.

F. Remove and replace malfunctioning devices and circuits and retest as specified above.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain systems. See Section 017900 "Demonstration and Training."

1. Train Owner's management and maintenance personnel in interpreting and using monitoring displays and in configuring and using software and reports. Include troubleshooting, servicing, adjusting, and maintaining equipment. Provide a minimum of 4 hours' training.
2. Training Aid: Use approved final versions of software and maintenance manuals as training aids.

END OF SECTION 260913

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Photoelectric switches.
2. Indoor occupancy switchbox-mounted occupancy and outdoor motion sensors.

B. Related Requirements:

1. Section 262726 "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data

PART 2 - PRODUCTS

2.1 OUTDOOR PHOTOELECTRIC SWITCHES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Cooper Industries, Inc.
2. Leviton Manufacturing Co., Inc.

B. Description: Solid state, with SPST dry contacts rated for 1800 VA, to operate connected load, complying with UL 773.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range.
3. Time Delay: Thirty-second minimum, to prevent false operation.
4. Lightning Arrester: Air-gap type.
5. Mounting: Twist lock complying with NEMA C136.10, with base.

2.2 INDOOR OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Bryant Electric.
2. Cooper Industries, Inc.
3. Hubbell Building Automation, Inc.
4. Leviton Manufacturing Co., Inc.
5. Lithonia Lighting; Acuity Brands Lighting, Inc.
6. Lutron Electronics Co., Inc.
7. Philips Lighting Controls.
8. Sensor Switch, Inc.
9. Watt Stopper.

B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
5. Mounting:
    a. Sensor: Suitable for mounting in any position on a standard outlet box.
    b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
    c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
7. Bypass Switch: Override the "on" function in case of sensor failure.
8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.

C. PIR Type: Ceiling mounted; detect occupants in coverage area by their heat and movement.

1. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in.
2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.
3. Detection Coverage (Corridor): Detect occupancy within 90 feet when mounted on a 10-foot-high ceiling.

D. Ultrasonic Type: Ceiling mounted; detect occupants in coverage area through pattern changes of reflected ultrasonic energy.

1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. when mounted on a 96-inch-high ceiling.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.
4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch-high ceiling.

5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet when mounted on a 10-foot-high ceiling in a corridor not wider than 14 feet.

E. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.

2.3 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Bryant Electric.
2. Cooper Industries, Inc.
3. Hubbell Building Automation, Inc.
4. Leviton Manufacturing Co., Inc.
5. Lithonia Lighting; Acuity Brands Lighting, Inc.
6. Lutron Electronics Co., Inc.
7. Philips Lighting Controls.
8. Sensor Switch, Inc.
9. Watt Stopper.

B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application, and shall comply with California Title 24.
2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
3. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.

C. Wall-Switch Sensor Tag WS1:

1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of **900 sq. ft.**
2. Sensing Technology: Dual technology - PIR and ultrasonic.
3. Switch Type: SP, field selectable automatic "on," or manual "on" automatic "off."
4. Voltage: Match the circuit voltage; dual-technology type.
5. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
6. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
7. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.

D. Wall-Switch Sensor Tag WS2:

1. Standard Range: 210-degree field of view, with a minimum coverage area of 900 sq. ft.
2. Sensing Technology: PIR.
3. Switch Type: SP, field selectable automatic "on," or manual "on" automatic "off."
4. Voltage: Match the circuit voltage; dual-technology type.

5. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
6. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
7. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.

2.4 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

B. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.

C. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

D. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.

E. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate lighting control devices and perform tests and inspections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Lighting control devices will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 260923

SECTION 260926 - LIGHTING CONTROL PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Lighting controls using electrically operated circuit breakers.

1.2 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.

B. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.

C. RS-485: A serial network protocol, similar to RS-232, complying with TIA-485-A.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each lighting control panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail bus configuration, current, and voltage ratings.
3. Short-circuit current rating of panelboards and overcurrent protective devices.

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For panelboards, accessories, and components, from manufacturer.

B. Field quality-control reports.

C. Sample Warranty: For manufacturer's special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Printout of software application and graphic screens.
4. Device address list.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Eaton.
2. Lithonia Lighting; Acuity Brands Lighting, Inc.
3. Square D; by Schneider Electric.

2.2 SYSTEM DESCRIPTION

A. Input signal from field-mounted or on-board signal source shall open or close one or more electrically operated circuit breakers in the lighting control panelboards. Any combination of inputs shall be programmable to any combination outputs.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with 47 CFR, Subpart A and Subpart B, for Class A digital devices.

2.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards 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 when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
2. Component Importance Factor: 1.5.

2.4 PANELBOARDS

A. The lighting panelboards may contain remotely operated circuit breakers and standard branch circuit breakers specified in Section 262416 "Panelboards."

B. Assemblies: Comply with UL 67 and NEMA PB 1.

C. Surge Protective Device: Field mounted, complying with Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits."

D. Surge Protective Device: Integrally mounted, complying with UL 1449 Type 1.

1. Comply with IEEE C62.41, Category C, 200-kA short-circuit current rating.
2. Non-modular type with the following features and accessories:

a. Digital-display indicator lights for power and protection status.

E. Enclosures: Comply with UL 50 and NEMA 250.

F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

G. Panelboard Short-Circuit Current Rating: Fully rated to interrupt 10-kA symmetrical short-circuit current available at terminals.

2.5 CIRCUIT BREAKERS

A. Remotely operated branch circuit breakers used for lighting control shall provide branch-circuit overcurrent protection.

B. Labeled with SWD and HID Ratings: Comply with UL 489 for 15- and 20-A, single-pole branch devices.

C. Switching Endurance Rating: Not less than 50,000 full-load open/close/open remote operations.

D. Remotely Operated Circuit Breakers: Manual override switch or handle position shall enable or disable the remote operation of the device and allow breaker handle to manually control the breaker's on-off status.

2.6 CONTROLLERS

A. Description: Controllers shall contain the power supply and electronic control for operating and monitoring remotely operated branch circuit breakers.

1. Comply with UL 916; with a microprocessor-based, solid-state, 365-day timing and control unit.
2. Power Supply: Powered from the panelboard, sized to provide control power for the operation of the remotely operated circuit breakers, controller, bus system, low-voltage inputs, field-installed occupancy sensors, and low-voltage photo sensors.
3. Integral keypad and digital-display front panel for local setup, including the following:

a. Blink notice, time adjustable from software.
b. Ability to log and display remotely operated breaker on-time.
c. Capability for accepting downloadable firmware so that the latest production features may be added in the future without replacing the module.

4. Nonvolatile memory shall retain all setup configurations. After a power failure, the controller shall automatically reboot and return to normal system operation.
5. Time Synchronization: The timing unit shall be updated not less than every hour(s) with the network time server.

B. Timing Unit:

1. 365-day calendar, astronomical clock, and automatic adjustments for daylight savings and leap year.
2. Clock configurable for 12-hour (A.M./P.M.) or 24-hour format.

3. 16 independent schedules, each having 24 time periods.
4. Schedule periods settable to the minute.
5. Day of week, day of month, day of year with one-time or repeating capability.
6. 32 special date periods.

C. With eight inputs, each configurable to the following parameters:

1. Normally open, normally closed, two-wire maintained toggle, two-wire momentary toggle, two-wire momentary on, two-wire momentary off, or three-wire momentary operation.
2. On and off-delay timers for local override operation, adjustable from five minutes to 12 hours. Local override shall be by field-installed, two-wire momentary toggle switch.

2.7 MANUAL SWITCHES AND PLATES

A. Keypads: Programmable, designed to control lighting applications and functions associated with the equipment of this Section. The units shall be able to control any system output device, including remotely operated circuit breakers, relays, dimmers, and analog outputs.

B. Push-Button Switches: Modular, momentary-contact, low-voltage type.

1. Match color specified in Section 262726 "Wiring Devices."
2. Integral green LED pilot light to indicate when circuit is on.
3. Internal white LED locator light to illuminate when circuit is off.

C. Manual, Maintained Contact, Full- or Low-Voltage Switch: Comply with Section 262726 "Wiring Devices."

D. Wall Plates: Single and multigang plates as specified in Section 262726 "Wiring Devices."

E. Legend: Engraved or permanently silk-screened on wall plate where indicated. Use designations indicated on Drawings.

2.8 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Class 2 Power Source: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Class 2 and Class 3 Control Cables: Multiconductor cable with copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cables: Multiconductor cable with copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 WIRING INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.

2. Comply with requirements for cable trays specified in Section 260536 "Cable Trays for Electrical Systems."
3. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

C. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.2 PANELBOARD INSTALLATION

A. Comply with NECA 1.

B. Install panelboards and accessories according to NECA 407.

C. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

D. Mounting Height: 90 inches to top of trim above finished floor unless otherwise indicated.

E. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

F. Install filler plates in unused spaces.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."

C. Create a directory to indicate loads served by each circuit; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are unacceptable.

D. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
c. Instruments and Equipment:

1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

C. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

D. Panelboard will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain control modules.

END OF SECTION 260926

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

1.2 DEFINITIONS

A. MCCB: Molded-case circuit breaker.

B. SPD: Surge protective device.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of panelboard.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Include evidence of NRTL listing for SPD as installed in panelboard.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include wiring diagrams for power, signal, and control wiring.
8. Key interlock scheme drawing and sequence of operations.
9. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

1.4 INFORMATIONAL SUBMITTALS

A. Panelboard schedules for installation in panelboards.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON REQUIREMENTS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA PB 1.

D. Comply with NFPA 70.

E. Enclosures: Flush and Surface-mounted, dead-front cabinets.

1. Rated for environmental conditions at installed location.

   a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
   b. Outdoor Locations: NEMA 250, Type 3R.
   c. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

2. Height: 84 inches maximum.
3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.

F. Incoming Mains Location: Convertible between top and bottom.

G. Phase, Neutral, and Ground Buses: Hard-drawn copper, 98 percent conductivity.

H. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
3. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

I. NRTL Label: Panelboards shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.

J. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

K. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards 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."

B. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 2.

2.3 POWER PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Eaton.
2. General Electric Company; GE Energy Management - Electrical Distribution.
3. Siemens Energy.
4. Square D; by Schneider Electric.

B. Panelboards: NEMA PB 1, distribution type.

C. Mains: Circuit breaker or Lugs only.

D. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Eaton.
2. General Electric Company; GE Energy Management - Electrical Distribution.
3. Siemens Energy.
4. Square D; by Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker or lugs only.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

F. Column-Type Panelboards: Single row of overcurrent devices with narrow gutter extension and overhead junction box equipped with ground and neutral terminal buses.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Eaton.
2. General Electric Company; GE Energy Management - Electrical Distribution.
3. Siemens Energy.
4. Square D; by Schneider Electric.

B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers:

a. Inverse time-current element for low-level overloads.
b. Instantaneous magnetic trip element for short circuits.
c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic Trip Circuit Breakers:

a. RMS sensing.
b. Field-replaceable rating plug or electronic trip.
c. Digital display of settings, trip targets, and indicated metering displays.
d. Multi-button keypad to access programmable functions and monitored data.
e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
f. Integral test jack for connection to portable test set or laptop computer.
g. Field-Adjustable Settings:

1) Instantaneous trip.
2) Long- and short-time pickup levels.
3) Long and short time adjustments.
4) Ground-fault pickup level, time delay, and I squared T response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. Subfeed Circuit Breakers: Vertically mounted.
6. MCCB Features and Accessories:

a. Standard frame sizes, trip ratings, and number of poles.
b. Breaker handle indicates tripped status.
c. UL listed for reverse connection without restrictive line or load ratings.
d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
f. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
g. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
h. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

1. Fuses and Spare-Fuse Cabinet: Comply with requirements specified in Section 262813 "Fuses."

2.6 IDENTIFICATION

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

C. Circuit Directory: Directory card inside panelboard door, mounted in transparent card holder.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install panelboards and accessories according to NECA 407.

C. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

D. Mount top of trim 90 inches above finished floor unless otherwise indicated.

E. Mount panelboard cabinet plumb and rigid without distortion of box.

F. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

G. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

H. Install filler plates in unused spaces.

I. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Weather-resistant receptacles.
3. Snap switches and wall-box dimmers.
4. Solid-state fan speed controls.
5. Wall-switch and exterior occupancy sensors.
6. Communications outlets.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Eaton (Arrow Hart).
2. Hubbell Incorporated; Wiring Device-Kellems.
3. Leviton Manufacturing Co., Inc.
4. Pass & Seymour/Legrand (Pass & Seymour).

B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, 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 NFPA 70.

C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with the requirements in this Section.

2.3 STRAIGHT-BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Eaton (Arrow Hart).
b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).

2.4 GFCI RECEPTACLES

A. General Description:

1. Straight blade, feed-through type.
2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Eaton (Arrow Hart).
b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).

2.5 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

1. Single Pole:
2. Two Pole:
3. Three Way:
4. Four Way:

C. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1) Eaton (Arrow Hart).
2) Hubbell Incorporated; Wiring Device-Kellems.
3) Leviton Manufacturing Co., Inc.
4) Pass & Seymour/Legrand (Pass & Seymour).

D. Pilot-Light Switches, 20 A:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Eaton (Arrow Hart).
b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Single pole, with neon-lighted handle, illuminated when switch is "off."

E. Key-Operated Switches, 120/277 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Eaton (Arrow Hart).
b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Single pole, with factory-supplied key in lieu of switch handle.

2.6 DECORATOR-STYLE DEVICES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Eaton (Arrow Hart).
b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).

B. Convenience Receptacles: Square face, 125 V, 15 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R, and UL 498.

C. GFCI, Feed-Through Type, Convenience Receptacles: Square face, 125 V, 15 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-15R, UL 498, and UL 943 Class A.

D. Toggle Switches, Square Face, 120/277 V, 15 A: Comply with NEMA WD 1, UL 20, and FS W-S-896.

E. Lighted Toggle Switches, Square Face, 120 V, 15 A: Comply with NEMA WD 1 and UL 20.

1. Description: With neon-lighted handle, illuminated when switch is "off."

2.7 WALL-BOX DIMMERS

A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.

B. Control: Continuously adjustable toggle switch; with single-pole or three-way switching. Comply with UL 1472.

C. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.

1. 600 W; dimmers shall require no derating when ganged with other devices. Illuminated when "off."

2.8 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Steel with white baked enamel, suitable for field painting.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

2.9 FINISHES

A. Device Color:

1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red.
3. TVSS Devices: Blue.

B. Wall Plate Color: For plastic covers, match device color.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

    a. Cut back and pigtail, or replace all damaged conductors.
    b. Straighten conductors that remain and remove corrosion and foreign matter.
    c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

C. Wiring device will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 262726

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cartridge fuses rated 600 V ac and less for use in the following:

a. Control circuits.
b. Motor-control centers.
c. Enclosed controllers.
d. Enclosed switches.
e. Fused Disconnects

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Bussmann, an Eaton business.
2. Edison; a brand of Bussmann by Eaton.
3. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

1. Type RK-1: 250-V, zero- to 600-A rating, 200 kAIC.
2. Type RK-5: 250-V, zero- to 600-A rating, 200 kAIC.
3. Type T: 250-V, zero- to 1200-A rating, 200 kAIC, very fast acting.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install spare-fuse cabinet(s) in location shown on the Drawings or as indicated in the field by Owner.

3.2 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Receptacle switches.
4. Shunt trip switches.
5. Molded-case circuit breakers (MCCBs).
6. Enclosures.

1.2 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed switches and circuit breakers 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."

1.4 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.

B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.7 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. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Eaton.
2. Siemens Industry, Inc.
3. Square D; by Schneider Electric.

B. Type GD, General Duty, Single Throw, 240-V ac, 800 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with cartridge fuse interiors to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Single Throw, 240-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Type HD, Heavy Duty, Six Pole, Single Throw, 240-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

E. Type HD, Heavy Duty, Double Throw, 240-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

F. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Lugs: Suitable for number, size, and conductor material.
5. Service-Rated Switches: Labeled for use as service equipment.

2.2 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. General Electric Company.

2. Siemens Industry, Inc.
3. Square D; by Schneider Electric.

B. Type GD, General Duty, Single Throw, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Single Throw, 240-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Type HD, Heavy Duty, Six Pole, Single Throw, 240-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

E. Type HD, Heavy Duty, Double Throw, 240-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

F. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Lugs: Suitable for number, size, and conductor material.

2.3 RECEPTACLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Eaton.
2. General Electric Company.
3. Siemens Industry, Inc.
4. Square D; by Schneider Electric.

B. Type HD, Heavy-Duty, Single-Throw Fusible Switch: 240-V ac, 30 A; UL 98 and NEMA KS 1; horsepower rated, with clips or bolt pads to accommodate specified fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

C. Type HD, Heavy-Duty, Single-Throw Nonfusible Switch: 240-V ac, 30 A; UL 98 and NEMA KS 1; horsepower rated, lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

D. Interlocking Linkage: Provided between the receptacle and switch mechanism to prevent inserting or removing plug while switch is in the on position, inserting any plug other than specified, and turning switch on if an incorrect plug is inserted or correct plug has not been fully inserted into the receptacle.

E. Receptacle: Polarized, three-phase, four-wire receptacle (fourth wire connected to enclosure ground lug).

2.4 SHUNT TRIP SWITCHES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Bussmann, an Eaton business.
2. Littelfuse, Inc.

3. Mersen USA.

B. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.

C. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

D. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses, with a control power transformer of enough capacity to operate shunt trip, connected pilot, and indicating and control devices.

E. Accessories:

1. Oiltight key switch for key-to-test function.
2. Oiltight ON pilot light.
3. Isolated neutral lug.
4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
5. Form C alarm contacts that change state when switch is tripped.
6. Three-pole, double-throw, fire-safety and alarm relay; 120-V ac coil voltage.
7. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.

2.5 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Eaton.
2. General Electric Company.
3. Siemens Industry, Inc.
4. Square D; by Schneider Electric.

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

D. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and I^2t response.

E. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

F. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test

feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
6. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
7. Alarm Switch: One NO contact that operates only when circuit breaker has tripped.

2.6 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NECA 1.

3.2 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 262816

SECTION 262923 - VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes separately enclosed, preassembled, combination VFCs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.

B. See Section 262419 "Motor-Control Centers" for VFCs installed in motor-control centers.

1.2 DEFINITIONS

A. CE: Conformite Europeene (European Compliance).

B. CPT: Control power transformer.

C. DDC: Direct digital control.

D. EMI: Electromagnetic interference.

E. OCPD: Overcurrent protective device.

F. PID: Control action, proportional plus integral plus derivative.

G. RFI: Radio-frequency interference.

H. VFC: Variable-frequency motor controller.

1.3 ACTION SUBMITTALS

A. Product Data: For each type and rating of VFC indicated.

B. Shop Drawings: For each VFC indicated.

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.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Seismic Qualification Certificates: For each VFC, accessories, and components, from manufacturer.

1. Certificate of compliance.
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.

C. Product certificates.

D. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace VFCs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Eaton.
2. Rockwell Automation, Inc.
3. Schneider Electric USA, Inc.
4. Siemens Industry, Inc.
5. Yaskawa Electric America, Inc.

2.2 SYSTEM DESCRIPTION

A. General Requirements for VFCs:

1. VFCs and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508A.

B. Application: variable torque.

C. VFC Description: Variable-frequency motor controller, consisting of power converter that employs pulse-width-modulated inverter, factory built and tested in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.

1. Units suitable for operation of NEMA MG 1 motors.
2. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.

D. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

E. Output Rating: Three phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.

F. Unit Operating Requirements:

1. Input AC Voltage Tolerance: Plus 10 and minus 10 percent of VFC input voltage rating.
2. Input AC Voltage Unbalance: Not exceeding 3 percent.
3. Input Frequency Tolerance: Plus or minus 3 percent of VFC frequency rating.
4. Minimum Efficiency: 96 percent at 60 Hz, full load.
5. Minimum Displacement Primary-Side Power Factor: 96 percent under any load or speed condition.
6. Minimum Short-Circuit Current (Withstand) Rating: 10 kA.
7. Ambient Temperature Rating: Not less than 32 deg F and not exceeding 104 deg F.
8. Humidity Rating: Less than 95 percent (noncondensing).
9. Altitude Rating: Not exceeding 3300 feet.
10. Vibration Withstand: Comply with NEMA ICS 61800-2.
11. Overload Capability: 1.1 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.
12. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.
13. Speed Regulation: Plus or minus 5 percent.
14. Output Carrier Frequency: Selectable; 0.5 to 15 kHz.
15. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.

G. Inverter Logic: Microprocessor based, 16 bit, isolated from all power circuits.

H. Isolated Control Interface: Allows VFCs to follow remote-control signal over a minimum 40:1 speed range.

1. Signal: Electrical.

I. Internal Adjustability Capabilities:

1. Minimum Speed: 5 to 25 percent of maximum rpm.
2. Maximum Speed: 80 to 100 percent of maximum rpm.
3. Acceleration: 0.1 to 999.9 seconds.
4. Deceleration: 0.1 to 999.9 seconds.
5. Current Limit: 30 to minimum of 150 percent of maximum rating.

J. Self-Protection and Reliability Features:

1. Surge Suppression: Field-mounted surge suppressors complying with Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits," UL 1449 SPD, Type 2.
2. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
3. Under- and overvoltage trips.
4. Inverter overcurrent trips.
5. VFC and Motor-Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for providing VFC overtemperature and motor-overload alarm and trip; settings selectable via the keypad.
6. Critical frequency rejection, with three selectable, adjustable deadbands.
7. Instantaneous line-to-line and line-to-ground overcurrent trips.
8. Loss-of-phase protection.
9. Reverse-phase protection.
10. Short-circuit protection.
11. Motor-overtemperature fault.

K. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.

L. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.

M. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

N. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.

O. Integral Input Disconnecting Means and OCPD: UL 489, instantaneous-trip circuit breaker with pad-lockable, door-mounted handle mechanism.

1. Disconnect Rating: Not less than 115 percent of VFC input current rating.
2. Auxiliary contacts "a" and "b" arranged to activate with circuit-breaker handle.

2.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: VFCs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7. The designated VFCs shall be tested and certified by an NRTL as meeting the ICC-ES AC 156 test procedure requirements.

1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.4 CONTROLS AND INDICATION

A. Status Lights: Door-mounted LED indicators displaying the following conditions:

1. Power on.
2. Run.
3. Overvoltage.
4. Line fault.
5. Overcurrent.
6. External fault.

B. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English-language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.

1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.
2. Security Access: Provide electronic security access to controls through identification and password with at least one level of access: View only; view and operate; and view, operate, and service.

a. Control Authority: Supports at least four conditions: Off, local manual control at VFC, local automatic control at VFC, and automatic control through a remote source.

C. Historical Logging Information and Displays:

1. Real-time clock with current time and date.
2. Running log of total power versus time.
3. Total run time.
4. Fault log, maintaining last four faults with time and date stamp for each.

D. Indicating Devices: Digital display and additional readout devices as required, mounted flush in VFC door and connected to display VFC parameters including, but not limited to:

1. Output frequency (Hz).
2. Motor speed (rpm).
3. Motor status (running, stop, fault).
4. Motor current (amperes).
5. Motor torque (percent).
6. Fault or alarming status (code).
7. PID feedback signal (percent).
8. DC-link voltage (V dc).
9. Set point frequency (Hz).
10. Motor output voltage (V ac).

E. Control Signal Interfaces:

1. Electric Input Signal Interface:

   a. A minimum of two programmable analog inputs: 0- to 10-V dc or 4- to 20-mA dc whatever is compatible with the control system.
   b. A minimum of six multifunction programmable digital inputs.

2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the DDC system for HVAC or other control systems:

   a. 0- to 10-V dc.
   b. 4- to 20-mA dc.
   c. Potentiometer using up/down digital inputs.
   d. Fixed frequencies using digital inputs.

3. Output Signal Interface: A minimum of one programmable analog output signal(s) (0- to 10-V dc or 4- to 20-mA dc whatever is compatible with the control system), which can be configured for any of the following:

   a. Output frequency (Hz).
   b. Output current (load).
   c. DC-link voltage (V dc).
   d. Motor torque (percent).
   e. Motor speed (rpm).
   f. Set point frequency (Hz).

F. PID Control Interface: Provides closed-loop set point, differential feedback control in response to dual feedback signals. Allows for closed-loop control of fans and pumps for pressure, flow, or temperature regulation.

1. Number of Loops: One.

2.5 OPTIONAL FEATURES

A. Damper control circuit with end-of-travel feedback capability.

B. Communication Port: RS-232 port, USB 2.0 port, or equivalent connection capable of connecting a printer and a notebook computer.

2.6 ENCLOSURES

A. VFC Enclosures: NEMA 250, to comply with environmental conditions at installed location.

1. Dry and Clean Indoor Locations: Type 1.
2. Outdoor Locations: Type 3R.

3. Other Wet or Damp Indoor Locations: Type 4.
4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.

B. Plenum Rating: UL 1995; NRTL certification label on enclosure, clearly identifying VFC as "Plenum Rated."

2.7 ACCESSORIES

A. General Requirements for Control-Circuit and Pilot Devices: NEMA ICS 5; factory installed in VFC enclosure cover unless otherwise indicated.

1. Push Buttons: Covered.
2. Pilot Lights: Push to test.
3. Selector Switches: Rotary type.

B. Control Relays: Auxiliary and adjustable solid-state time-delay relays.

C. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.

1. Current Transformers: Continuous current rating, basic impulse insulating level (BIL) rating, burden, and accuracy class suitable for connected circuitry. Comply with IEEE C57.13.

D. Supplemental Digital Meters:

1. Elapsed-time meter.
2. Kilowatt meter.
3. Kilowatt-hour meter.

E. Breather and drain assemblies, to maintain interior pressure and release condensation in NEMA 250, Type 4 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

F. Space heaters, with NC auxiliary contacts, to mitigate condensation in NEMA 250, Type 3R enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

G. Cooling Fan and Exhaust System: For NEMA 250, Type 1; UL 508 component recognized: Supply fan, with composite intake and exhaust grills and filters; 120-V ac; obtained from integral CPT.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Wall-Mounting Controllers: Install with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished floor, unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."

B. Roof-Mounting Controllers: Install VFC on roofs with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished roof surface unless otherwise indicated, and by bolting units to curbs or mounting on freestanding, lightweight, structural-steel channels bolted to curbs. Seal roof penetrations after raceways are installed.

1. Curbs and roof penetrations are specified in Section 077200 "Roof Accessories."

2. Structural-steel channels are specified in Section 260529 "Hangers and Supports for Electrical Systems."

C. Seismic Bracing: Comply with requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

E. Install fuses in control circuits if not factory installed. Comply with requirements in Section 262813 "Fuses."

F. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors are installed.

G. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

H. Comply with NECA 1.

3.2 IDENTIFICATION

A. Identify VFCs, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each VFC with engraved nameplate.
3. Label each enclosure-mounted control and pilot device.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections with the assistance of a factory-authorized service representative.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Inspect VFC, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Test insulation resistance for each VFC element, component, connecting motor supply, feeder, and control circuits.
3. Test continuity of each circuit.
4. Verify that voltages at VFC locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Construction Manager before starting the motor(s).
5. Test each motor for proper phase rotation.
6. Perform tests according to the Inspection and Test Procedures for Adjustable Speed Drives stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. VFCs will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.4 ADJUSTING

A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

B. Set the taps on reduced-voltage autotransformer controllers.

C. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Overcurrent Protective Device Coordination Study."

D. Set field-adjustable pressure switches.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, reprogram, and maintain VFCs.

END OF SECTION 262923

SECTION 263213 - ENGINE GENERATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes packaged engine-generator sets for emergency power supply with the following features:

1. Gas engine.
2. Unit-mounted cooling system.
3. Unit-mounted control and monitoring.
4. Performance requirements for sensitive loads.
5. Fuel system.
6. Outdoor enclosure.

B. Related Requirements:

1. Section 263600 "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include plans and elevations for engine-generator set and other components specified. Indicate access requirements affected by height of subbase fuel tank.
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.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For [Installer] [manufacturer] [and] [testing agency].

B. Seismic Qualification Certificates: For engine-generator set, 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: With engine and generator mounted on rails identify center of gravity and total weight including full fuel tank, supplied enclosure, external silencer, subbase-mounted fuel tank, and each piece of equipment not integral to the engine-generator set, 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.

C. Source quality-control reports, including, but not limited to the following:

1. Certified summary of prototype-unit test report.
2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
3. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.

4. Report of sound generation.
5. Report of exhaust emissions showing compliance with applicable regulations.
6. Certified Torsional Vibration Compatibility: Comply with NFPA 110.

D. Field quality-control reports.

E. Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 2 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Caterpillar, Inc.; Electric Power Division.
2. Cummins Power Generation.
3. Generac Power Systems, Inc.
4. Kohler Power Systems.
5. MTU Onsite Energy Corporation.

B. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Engine-generator set housing, engine-generator set, batteries, battery racks, silencers, and sound attenuating equipment, accessories, and components 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 when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Shake-table testing shall comply with ICC-ES AC156. Testing shall be performed with all fluids at worst case normal levels.
3. Component Importance Factor: 1.5.

B. ASME Compliance: Comply with ASME B15.1.

C. NFPA Compliance:

1. Comply with NFPA 37.
2. Comply with NFPA 70.
3. Comply with NFPA 99.
4. Comply with NFPA 110 requirements for Level 1 emergency power supply system.

D. UL Compliance: Comply with UL 2200.

E. Engine Exhaust Emissions: Comply with EPA Tier 2 requirements and applicable state and local government requirements.

F. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

G. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient Temperature: 5 to 40 deg C.
2. Relative Humidity: Zero to 95 percent.
3. Altitude: Sea level to 1000 feet.

2.3 ASSEMBLY DESCRIPTION

A. Factory-assembled and -tested, water-cooled engine, with brushless generator and accessories.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.

C. EPSS Class: Engine-generator set shall be classified as a Class 2 in accordance with NFPA 110.

D. Induction Method: [Naturally aspirated] [Turbocharged].

E. Governor: Adjustable isochronous, with speed sensing.

F. Emissions: Comply with EPA Tier 2 requirements.

G. Mounting Frame: Structural steel framework to maintain alignment of mounted components without depending on concrete foundation. Provide lifting attachments sized and spaced to prevent deflection of base during lifting and moving.

H. Capacities and Characteristics:

1. Power Output Ratings: Nominal ratings as indicated at 0.8 power factor excluding power required for the continued and repeated operation of the unit and auxiliaries, with capacity as required to operate as a unit as evidenced by records of prototype testing.
2. Output Connections: Three-phase, four wire.
3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.

I. Generator-Set Performance:

1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
7. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
8. Start Time: Comply with NFPA 110, Type 10, system requirements.

2.4 ENGINE

A. Fuel: Natural gas.

B. Rated Engine Speed: 1800 rpm.

C. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm.

D. Lubrication System: The following items are mounted on engine or skid:

1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

E. Jacket Coolant Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.

F. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.

1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.

G. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.

1. Minimum sound attenuation of 25 dB at 500 Hz.
2. Sound level measured at a distance of 25 feet from exhaust discharge after installation is complete shall be 78 dBA or less.

H. Air-Intake Filter: Standard-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

I. Starting System: 12-V electric, with negative ground.

1. Components: Sized so they are not damaged during a full engine-cranking cycle with ambient temperature at maximum specified in "Performance Requirements" Article.
2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
3. Cranking Cycle: As required by NFPA 110 for system level specified 60 seconds.
4. Battery: Nicad, with capacity within ambient temperature range specified in "Performance Requirements" Article to provide specified cranking cycle at least three times without recharging.
5. Battery Stand: Factory-fabricated, two-tier metal with acid-resistant finish designed to hold the quantity of battery cells required and to maintain the arrangement to minimize lengths of battery interconnections.
6. Battery Charger: Current-limiting, automatic-equalizing and float-charging type designed for Nicad batteries. Unit shall comply with UL 1236.

2.5 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms.

B. Provide minimum run time control set for 15 minutes with override only by operation of an emergency-stop switch.

C. Comply with UL 508A.

D. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration. Panel shall be powered from the engine-generator set battery.

E. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common wall-mounted control and monitoring panel. Panel shall be powered from the engine-generator set battery.

1. Wall-Mounting Cabinet Construction: Rigid, self-supporting steel unit complying with NEMA ICS 6. Power bus shall be copper. Bus, bus supports, control wiring, and temperature rise shall comply with UL 891.
2. Switchboard Construction: Freestanding unit complying with Section 262413 "Switchboards."
3. Switchgear Construction: Freestanding unit complying with Section 262300 "Low-Voltage Switchgear."

F. Indicating Devices : As required by NFPA 110 for Level 1 system, including the following:

1. AC voltmeter.
2. AC ammeter.
3. AC frequency meter.
4. EPS supplying load indicator.
5. Ammeter and voltmeter phase-selector switches.

6. DC voltmeter (alternator battery charging).
7. Engine-coolant temperature gage.
8. Engine lubricating-oil pressure gage.
9. Running-time meter.
10. Current and Potential Transformers: Instrument accuracy class.

G. Protective Devices and Controls in Local Control Panel: Shutdown devices and common visual alarm indication as required by NFPA 110 for Level 1 system, including the following:

1. Start-stop switch.
2. Overcrank shutdown device.
3. Overspeed shutdown device.
4. Coolant high-temperature shutdown device.
5. Coolant low-level shutdown device.
6. Low lube oil pressure shutdown device.
7. Air shutdown damper shutdown device when used.
8. Overcrank alarm.
9. Overspeed alarm.
10. Coolant high-temperature alarm.
11. Coolant low-temperature alarm.
12. Coolant low-level alarm.
13. Low lube oil pressure alarm.
14. Air shutdown damper alarm when used.
15. Lamp test.
16. Contacts for local common alarm.
17. Coolant high-temperature prealarm.
18. Generator-voltage adjusting rheostat.
19. Run-Off-Auto switch.
20. Control switch not in automatic position alarm.
21. Low cranking voltage alarm.
22. Battery-charger malfunction alarm.
23. Battery low-voltage alarm.
24. Battery high-voltage alarm.
25. Generator overcurrent protective device not closed alarm.

H. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

2.6 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Overcurrent protective devices for the entire EPSS shall be coordinated to optimize selective tripping when a short circuit occurs. Coordination of protective devices shall consider both utility and EPSS as the voltage source.

1. Overcurrent protective devices for the EPSS shall be accessible only to authorized personnel.

B. Generator Circuit Breaker: Molded-case, electronic-trip type; 100 percent rated; complying with UL 489.

1. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
2. Trip Settings: Selected to coordinate with generator thermal damage curve.
3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
4. Mounting: Adjacent to or integrated with control and monitoring panel.

C. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground fault.

1. Indicate ground fault with other generator-set alarm indications.
2. Trip generator protective device on ground fault.

D. For circuit breakers that are rated for or can be adjusted to 1,200 amperes or higher, provide arc energy reduction capability with an energy-reducing maintenance switch with local status indicator.

2.7 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H or Class F.

D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required. Provide six lead alternator.

E. Range: Provide extended range of output voltage by adjusting the excitation level.

F. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

G. Enclosure: Dripproof.

H. Instrument Transformers: Mounted within generator enclosure.

I. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified and as required by NFPA 110.

1. Adjusting Rheostat on Control and Monitoring Panel: Provide plus or minus 5 percent adjustment of output-voltage operating band.

J. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

K. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

L. Subtransient Reactance: 12 percent, maximum.

2.8 OUTDOOR GENERATOR-SET ENCLOSURE

A. Description: Vandal-resistant, sound-attenuating, weatherproof steel housing, wind resistant up to 100 mph. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.

B. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.

1. Louvers: Fixed-engine, cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.
2. Automatic Dampers: At engine cooling-air inlet and discharge. Dampers shall be closed to reduce enclosure heat loss in cold weather when unit is not operating.
3. Ventilation: Provide temperature-controlled exhaust fan interlocked to prevent operation when engine is running.

C. Interior Lights with Switch: Factory-wired, vapor-proof fixtures within housing; arranged to illuminate controls and accessible interior. Arrange for external electrical connection.

1. AC lighting system and connection point for operation when remote source is available.
2. DC lighting system for operation when remote source and generator are both unavailable.

D. Convenience Outlets: Factory wired, GFCI. Arrange for external electrical connection.

2.9 VIBRATION ISOLATION DEVICES

A. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch-thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Outside Spring Diameter: Not less than 80 percent of compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of 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. Minimum Deflection: 1 inch.

B. Vibration isolation devices shall not be used to accommodate misalignments or to make bends.

2.10 FINISHES

A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.11 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.

1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.

B. Equipment Mounting:

1. Install packaged engine generators on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Coordinate size and location of concrete bases for packaged engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

C. Install packaged engine-generator to provide access, without removing connections or accessories, for periodic maintenance.

D. Install packaged engine-generator with restrained spring isolators having a minimum deflection of 1 inch on 4-inch-high concrete base. Secure enclosure to anchor bolts installed in concrete bases. Concrete base construction is specified in Section 260548.16 "Seismic Controls for Electrical Systems."

E. Install Schedule 40, black steel piping with welded joints and connect to engine muffler. Install thimble at wall. Piping shall be same diameter as muffler outlet.

1. Install flexible connectors and steel piping materials according to requirements in Section 232116 Hydronic Piping Specialties."
2. Insulate muffler/silencer and exhaust system components according to requirements in Section 230719 "HVAC Piping Insulation."
3. Install isolating thimbles where exhaust piping penetrates combustible surfaces with a minimum of 9 inches clearance from combustibles.

F. Install condensate drain piping to muffler drain outlet full size of drain connection with a shutoff valve, stainless-steel flexible connector, and Schedule 40, black steel pipe with welded joints.

G. Installation requirements for piping materials and flexible connectors are specified in Section 232116 "Hydronic Piping Specialties." Copper and galvanized steel shall not be used in the fuel-oil piping system.

H. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.2 CONNECTIONS

A. Connect cooling-system water piping to engine-generator set and heat exchanger with flexible connectors.

B. Connect engine exhaust pipe to engine with flexible connector.

C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Provide a minimum of one 90 degree bend in flexible conduit routed to the generator set from a stationary element.

E. Balance single-phase loads to obtain a maximum of 10 percent unbalance between any two phases.

3.3 IDENTIFICATION

A. Identify system components according to Section 230553 "Identification for HVAC Piping and Equipment" and Section 260553 "Identification for Electrical Systems."

B. Install a sign indicating the generator neutral is bonded to the main service neutral at the main service location.

3.4 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.

B. Tests and Inspections:

1. Perform tests recommended by manufacturer and each visual and mechanical inspection and electrical and mechanical test listed in the first two subparagraphs as specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.

    a. Visual and Mechanical Inspection

        1) Compare equipment nameplate data with drawings and specifications.
        2) Inspect physical and mechanical condition.
        3) Inspect anchorage, alignment, and grounding.
        4) Verify the unit is clean.

    b. Electrical and Mechanical Tests

        1) Perform insulation-resistance tests in accordance with IEEE 43.

            a) Machines larger than 200 horsepower. Test duration shall be 10 minutes. Calculate polarization index.
            b) Machines 200 horsepower or less. Test duration shall be one minute. Calculate the dielectric-absorption ratio.

        2) Test protective relay devices.
        3) Verify phase rotation, phasing, and synchronized operation as required by the application.
        4) Functionally test engine shutdown for low oil pressure, overtemperature, overspeed, and other protection features as applicable.
        5) Conduct performance test in accordance with NFPA 110.
        6) Verify correct functioning of the governor and regulator.

2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.

    a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
    b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
    c. Verify acceptance of charge for each element of the battery after discharge.
    d. Verify that measurements are within manufacturer's specifications.

4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
6. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg. Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
7. Exhaust Emissions Test: Comply with applicable government test criteria.
8. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
9. Harmonic-Content Tests: Measure harmonic content of output voltage at 25 percent and 100 percent of rated linear load. Verify that harmonic content is within specified limits.
10. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at four locations on the property line, and compare measured levels with required values.

C. Coordinate tests with tests for transfer switches and run them concurrently.

D. Test instruments shall have been calibrated within the last 12 months, traceable to NIST Calibration Services, and adequate for making positive observation of test results. Make calibration records available for examination on request.

E. Leak Test: After installation, charge exhaust, coolant, and fuel systems and test for leaks. Repair leaks and retest until no leaks exist.

F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation for generator and associated equipment.

G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

H. Remove and replace malfunctioning units and retest as specified above.

I. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

J. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.

END OF SECTION 263213

SECTION 263600 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes automatic transfer switches rated 600 V and less.

1.2 ACTION SUBMITTALS

A. Product Data: Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.

1.3 INFORMATIONAL SUBMITTALS

A. Manufacturer Seismic Qualification Certification: Submit certification that transfer switches accessories, and components will withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned 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.

B. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 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. Comply with NEMA ICS 1.

C. Comply with NFPA 70.

D. Comply with NFPA 99.

E. Comply with NFPA 110.

F. Comply with UL 1008 unless requirements of these Specifications are stricter.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Contactor Transfer Switches:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Cummins Power Generation.
    b. Eaton.
    c. Emerson.
    d. GE Zenith Controls.
    e. Generac Power Systems, Inc.
    f. General Electric Company.
    g. Kohler Power Systems.
    h. Russelectric, Inc.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.

B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.

C. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

E. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.

F. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.
2. Switch Action: Double throw; mechanically held in both directions.
3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.

G. Neutral Switching. Where four-pole switches are indicated, provide neutral pole switched simultaneously with phase poles.

H. Battery Charger: For generator starting batteries.

1. Float type rated 2 A.
2. Ammeter to display charging current.
3. Fused ac inputs and dc outputs.

I. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.3 AUTOMATIC TRANSFER SWITCHES

A. Comply with Level 1 equipment according to NFPA 110.

B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.

C. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.

D. Automatic Transfer-Switch Features:

1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
5. Test Switch: Simulate normal-source failure.
6. Switch-Position Pilot Lights: Indicate source to which load is connected.
7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.

    a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
    b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."

8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
11. Engine Shutdown Contacts: Instantaneous; shall initiate shutdown sequence at remote engine-generator controls after retransfer of load to normal source.
12. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30

days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:

a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
b. Push-button programming control with digital display of settings.
c. Integral battery operation of time switch when normal control power is not available.

2.4 SOURCE QUALITY CONTROL

A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details. See Section 260548.16 "Seismic Controls for Electrical Systems."

B. Identify components according to Section 260553 "Identification for Electrical Systems."

C. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 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 the following tests and inspections with the assistance of a factory-authorized service representative:

1. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
3. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

    a. Check for electrical continuity of circuits and for short circuits.
    b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
    c. Verify that manual transfer warnings are properly placed.
    d. Perform manual transfer operation.

4. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.

    a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
    b. Simulate loss of phase-to-ground voltage for each phase of normal source.
    c. Verify time-delay settings.
    d. Verify pickup and dropout voltages by data readout or inspection of control settings.
    e. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
    f. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

5. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.

    a. Verify grounding connections and locations and ratings of sensors.

C. Coordinate tests with tests of generator and run them concurrently.

D. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

E. Remove and replace malfunctioning units and retest as specified above.

F. Prepare test and inspection reports.

G. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.

1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
3. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to Section 017900 "Demonstration and Training."

B. Coordinate this training with that for generator equipment.

END OF SECTION 263600

SECTION 264313 - SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes field-mounted SPDs for low-voltage (120 to 600 V) power distribution and control equipment.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
2. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, Inominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Sample Warranty: For manufacturer's special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to replace or replace SPDs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL SPD REQUIREMENTS

A. SPD with Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Comply with UL 1449.

D. MCOV of the SPD shall be the nominal system voltage.

2.2 SERVICE ENTRANCE AND TRANSFER SWITCH SUPPRESSOR

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Eaton.
2. General Electric Company.
3. Schneider Electric USA, Inc.
4. Siemens Industry, Inc.
5. Square D; by Schneider Electric.
6. Surge Suppression Incorporated.

B. SPDs: Comply with UL 1449, Type 1.

1. SPDs with the following features and accessories:

a. Integral disconnect switch.
b. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
c. Indicator light display for protection status.

C. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 200 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

D. Protection modes and UL 1449 VPR for grounded wye circuits with 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral: 700 V for 208Y/120 V.
2. Line to Ground: 1200 V for 208Y/120 V.
3. Line to Line: 1000 V for 208Y/120 V.

E. Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits shall not exceed the following:

1. Line to Neutral: 700 V.
2. Line to Ground: 700 V.
3. Line to Line: 1000 V.

F. SCCR: Equal or exceed 100 kA.

G. Inominal Rating: 20 kA.

2.3 PANEL SUPPRESSORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Eaton.
2. General Electric Company.
3. Schneider Electric USA, Inc.
4. Siemens Industry, Inc.
5. Square D; by Schneider Electric.
6. Surge Suppression Incorporated.

B. SPDs: Comply with UL 1449, Type 1.

1. Include LED indicator lights for power and protection status.

2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.

C. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

D. Protection modes and UL 1449 VPR for grounded wye circuits with 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral: 700 V for 208Y/120 V.
2. Line to Ground: 700 V for 208Y/120 V.
3. Neutral to Ground: 700 V for 208Y/120 V.
4. Line to Line: 1200 V for 208Y/120 V

E. SCCR: Equal or exceed 100 kA.

F. Inominal Rating: 20 kA.

2.4 ENCLOSURES

A. Indoor Enclosures: NEMA 250, Type 1.

B. Outdoor Enclosures: NEMA 250, Type 3R.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.

C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible, and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

D. Use crimped connectors and splices only. Wire nuts are unacceptable.

E. Complete startup checks according to manufacturer's written instructions. Energize SPDs after power system has been energized, stabilized, and tested.

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.

1. Compare equipment nameplate data for compliance with Drawings and Specifications.
2. Inspect anchorage, alignment, grounding, and clearances.
3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

B. An SPD will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.3 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate and maintain SPDs.

END OF SECTION 264313

SECTION 265119 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior solid-state luminaires that use LED technology.
2. Lighting fixture supports.

B. Related Requirements:

1. Section 260923"Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Section 260926"Lighting Control Panelboards" for panelboards used for lighting control.

1.2 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, arranged by designation.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire 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.

C. LEED Submittals:

1. Product Data for Credit IEQ 4.2: For paints and coatings, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit IEQ 4.2: For paints and coatings, documentation indicating that products comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale and coordinated with each other, using input from installers of the items involved:

B. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.

C. Product Certificates: For each type of luminaire.

D. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.

1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.2 LUMINAIRE 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. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

D. Recessed Fixtures: Comply with NEMA LE 4.

E. CRI and CCT as indicated in luminaire schedule.

F. Rated lamp life of 50,000 hours.

G. Lamps dimmable from 100 percent to 0 percent of maximum light output.

H. Internal driver.

I. Nominal Operating Voltage: 120 V ac.

1. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

J. Housings:

1. As indicated luminaire schedule.

2.3 MATERIALS

1. As indicated in luminaire schedule.

2.4 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.5 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.

D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports: Sized and rated for luminaire weight.

E. Flush-Mounted Luminaire Support: Secured to outlet box.

F. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.
2. Do not attach luminaires directly to gypsum board.

G. Ceiling-Mounted Luminaire Support:

1. Ceiling mount with two 5/32-inch-diameter aircraft cable supports adjustable to 120 inches in length.
2. Ceiling mount with pendant mount with 5/32-inch-diameter aircraft cable supports adjustable to 120 inches in length.
3. Ceiling mount with hook mount.

H. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing, rod or wire support for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

I. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure luminaire using approved fasteners in a minimum of four locations, spaced near corners of luminaire.

J. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

K. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 265119

SECTION 265219 - EMERGENCY AND EXIT LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exit signs.
2. Luminaire supports.

1.2 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Emergency Lighting Unit: A lighting unit with integral or remote emergency battery powered supply and the means for controlling and charging the battery and unit operation.

D. Fixture: See "Luminaire" Paragraph.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of emergency lighting unit, exit sign, and emergency lighting support, arranged by designation.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting 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.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, coordinated with each other, using input from installers of the items involved:

B. Product Certificates: For each type of luminaire.

C. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.

D. Sample Warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two year(s) from date of Substantial Completion.

B. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.2 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

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. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.

C. Comply with NFPA 70 and NFPA 101.

D. Comply with NEMA LE 4 for recessed luminaires.

E. Comply with UL 1598 for recessed luminaires.

2.3 EXIT SIGNS

A. Internally Lighted Signs:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Cooper Lighting, an Eaton business.
b. Hubbell Industrial Lighting; Hubbell Incorporated.
c. Lithonia Lighting; Acuity Brands Lighting, Inc.
d. Philips Lighting Company.

2. Operating at nominal voltage of 120 V ac.

3. Lamps for AC Operation: Fluorescent, two for each fixture; 20,000 hours of rated lamp life.
4. Lamps for AC Operation: LEDs; 50,000 hours minimum rated lamp life.
5. Self-Powered Exit Signs (Battery Type): Internal emergency power unit.

2.4 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:

1. Sized and rated for luminaire and emergency power unit weight.
2. Able to maintain luminaire position when testing emergency power unit.
3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.

E. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.
2. Do not attach fixtures directly to gypsum board.

F. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of fixture oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing, rod or wire support for suspension for each unit length of fixture chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

G. Ceiling Grid Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure emergency power unit using approved fasteners in a minimum of four locations, spaced near corners of emergency power unit.

H. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 265219

SECTION 265619 - LED EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
2. Luminaire supports.
3. Luminaire-mounted photoelectric relays.

B. Related Requirements:

1. Section 260923"Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Section 260926"Lighting Control Panelboards" for panelboard-based lighting control.

1.2 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color rendering index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of luminaire.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire 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.

C. LEED Submittals:

1. Product Data for Credit EA 5: For specified metering equipment.
2. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

D. Delegated-Design Submittal: For luminaire supports.

1. Include design calculations for luminaire supports and seismic restraints.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale and coordinated.

B. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.

C. Product Certificates: For each type of the following:

1. Luminaire.
2. Photoelectric relay.

D. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.
2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

1.6 FIELD CONDITIONS

A. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.7 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 2 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.

1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.2 LUMINAIRE 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. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. UL Compliance: Comply with UL 1598 and listed for wet location.

D. Lamp base complying with ANSI C81.61 or IEC 60061-1.

E. CRI and CCT as indicated on luminaire schedule.

F. L70 lamp life of 50,000 Insert number hours.

G. Lamps dimmable from 100 percent to 0 percent of maximum light output.

H. Nominal Operating Voltage: 120 V ac.

I. In-line Fusing: On the primary for each luminaire.

J. Lamp Rating: Lamp marked for outdoor use and in enclosed locations.

K. Source Limitations: Obtain luminaires from single source from a single manufacturer.

L. Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.3 MATERIALS

A. Metal Parts: Free of burrs and sharp corners and edges.

B. Sheet Metal Components: Corrosion-resistant aluminum. Form and support to prevent warping and sagging.

C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.

D. Diffusers and Globes:

1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

F. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

G. Housings:

1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
2. Provide filter/breather for enclosed luminaires.

2.4 FINISHES

A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.

D. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

a. Color: As selected from manufacturer's standard catalog of colors.

2.5 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Comply with NECA 1.

B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Install lamps in each luminaire.

D. Fasten luminaire to structural support.

E. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Support luminaires without causing deflection of finished surface.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

F. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.

G. Wiring Method: Install cables in raceways. Conceal raceways and cables.

H. Install luminaires at height and aiming angle as indicated on Drawings.

I. Coordinate layout and installation of luminaires with other construction.

J. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.

K. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.2 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Verify operation of photoelectric controls.

C. Illumination Tests:

1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IES testing guide(s):

    a. IES LM-5.
    b. IES LM-50.
    c. IES LM-52.
    d. IES LM-64.
    e. IES LM-72.

2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

D. Luminaire will be considered defective if it does not pass tests and inspections.

E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain luminaires and photocell relays.

END OF SECTION 265619

SECTION 271000 – STRUCUTURED CABLING SYSTEMS

PART 1 – GENERAL

1.1 DISCRIPTION

A BASIC DEFINITIONS

1. Definitions:
   a. "Days": As used in the specifications, the word "days" means calendar days.
   b. "Provide": As used in the plans and specifications, the word "provide" means to furnish, install, connect, program, test, commission and warranty the subject material or services.

2. Specified Items – Substitutions
   a. "No Substitutes": The exact make and model number identified in the Specification shall be provided without exception. Where compatibility with existing systems is specified, and where a specific make or model number is not identified, the *Low Voltage* Contractor shall provide equipment which is compatible with, and equivalent to, existing equipment of the same description and type, and serving the same purpose.
   b. "Or Equal": An item may be substituted for the specified item provided that in every technical and aesthetic sense, the substituted item provides the same or better capability than the specified item, and is fully compatible with the new or existing systems specified. For expansion of existing systems, the item shall also be approved and fully supported by the existing system manufacturer. The *Structured Cabling* Engineer shall be the sole authority to determine the equality of substituted products with specified items.
   c. "Aesthetic", or "Aesthetic Considerations": If aesthetic considerations are involved in either the "or equal" or "approved equal" category, this shall be a consideration in approving or disapproving the proposed substitute. If the proposed substitute is aesthetically unacceptable to the Architect, then the specified, or another technically equal item, shall be provided.

3. "Beneficial Use": Each component of a system is not considered available for beneficial use until and unless all components and conditions have been fulfilled to make the system fully operational.

C DESCRIPTION

Section Includes: Installation, identification labeling and testing of connectivity and cabling.

1. Structured Telecommunications Cabling System Supporting:
   a. Data Networks
   b. Wireless Networks
   c. Fiber and Copper Backbone
2. Telecommunications Rooms and Spaces

1.2 TELECOMMUNICATIONS INFRASTRUCTURE SCOPE OF WORK

A. General:

1. Furnish all labor, materials, tools, equipment and services for the installation as indicated, in accordance with general provisions of specifications and the Contract Drawings.
2. Report percentage of work completed on a weekly basis.
3. Completely coordinate with work of all other trades for a complete and operational system.
4. Provide all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation, whether or not specifically indicated in the Contract Documents.
5. Floor penetrations, floor sleeves, conduit raceways, wall penetrations to be installed by electrical contractor
6. Provide labor for permanent link testing of owner CAT6 cabling and Wireless LAN Access Point.

7. Provide labor and material for CAT 6 Cabling to workstations, IP Cameras and Wireless Access Points
8. Provide labor and material for CAT 6, RG6 (or RG11 based on distance)
9. Provide labor and material for RG6 (or RG11 based on distance) to certain locations
10. Provide labor and material for fiber and copper backbone to IDFs throughout the property.
11. Provide labor to install customer provided Wireless access points.
16. Provide labor and material to buildout the Server and IDF rooms per the drawings and specs.
17. Provide telecommunications bonding and ground to telecommunication grounding busbar provided and installed by electrical contractor.
18. Provide labor and material to supply and install patch cords for common area and back of house of house locations for connection between patch panels and switches.
19. Provide (1) 10' patch cord for each workstation/users side. Patch Cords will be left in Server Room
20. Provide all necessary patch cords for connection from patch panel to customer provided switch

B. Provide complete installation of the telecommunications infrastructure including but not limited to:

1. Pathways including open cabling supports
2. Cable runway located within the Telecom Rooms
3. Penetration and Fire stopping materials for fire rate walls
4. Apartment Distribution Panels in each apartment
5. Horizontal micro-duct from IDFs to ADPs
6. Horizontal and backbone copper connectivity and cabling
7. Fiber backbone connectivity between Telecom Rooms and MPOE
8. Equipment mounting racks, wall mount enclosures and server enclosures
9. Horizontal and vertical cable management systems
10. Telecommunications bonding systems
11. Testing of the horizontal permanent link/qualifying cabling, and backbone cabling systems.
12. Wireless LAN cable installation, (Wireless LAN controllers, Access Points and Switches will be provided by others).
13. Patch Cords
14. Labeling and identification

C. Work and materials not included:

1. Wide Area Network equipment including routers, firewalls, modems and ASAs.
2. Local Area Network equipment including PoE switches.
3. Server hardware including application servers, Storage Area Network, application software and virtualization software.
4. Wireless LAN controllers, Access Points
5. Desktop PC computing devices and equipment.
6. Conduit
7. 120/208vac Outlets

1.3 SUBMITTALS

A. General: Bid documents, including plans, details and specifications are generally considered conceptual in nature, and provide direction on products and project requirements. In most cases, the Contractor is given a choice of products and methods that may be incorporated into the system. These choices may affect the overall design, configuration and installation of the proposed system.

B. All submittals shall be submitted at one time for approval. Partial submittals will not be considered.

C. Telecommunications Pre-Construction Submittal:

1. Submit in booklet form, with data arranged under basic categories, i.e., Certifications, Personnel Training, Manufacturer Warranty, Products, Test Equipment and Calibration, etc.
2. Submit (3) product submittal booklets.
3. Submittal shall include a typewritten index.

4. Submittal shall be organized by specification infrastructure component.
5. Submittal shall include dividers with identifying tabs between sections and references to section of the specifications.
6. Submit product data information sheets for approval and coordination with the item or model to be used clearly marked, showing ratings where appropriate.
7. Where more than one product is shown on a page, product shall be marked with an arrow or by other means to identify the exact product or products being submitted by specific part number.
8. Submittals shall be provided as one complete submittal. Partial submittals shall be rejected.
9. Submit the network test equipment including model number and serial number. Provide proof of calibration by the manufacturer.
10. Submit the resumes and certifications of all technicians and the project manager who will support this project. The certifications shall include:
    a. Copper and optical fiber installation certification
    b. Approved manufacturer classes satisfactorily completed

D. Pathway Shop Drawings:

1. Submit shop drawings of telecommunications cabling pathway system, wall and floor sleeves and raceway. *Low Voltage* Contractor shall coordinate with *General Contractor for coordination with other trades* prior to the submittal and start of installation.
2. Drawings shall show exact routing of all horizontal cabling for workstation distribution throughout the building, as well as all intrabuilding fiber and copper.
3. Drawings shall identify quantity and size of all raceways, floor and wall penetrations and cable management equipment used to route and protect horizontal and backbone cabling.
4. Indicate pathway loading, and identify all cabling included in each pathway run by cable quantity.
5. Individual cabling runs shall be indicated similarly.
6. Workstation devices shall be labeled to provide identification of cabling being terminated in the telecommunications rooms and spaces.
7. Verify pathways for Category 6 data cables do not exceed the maximum cable length of 295 feet (90 meters).
8. All pathway shop drawings shall be generated using a CAD software program.
9. Submit shop drawings for approval and coordination.
10. Prior to submitting telecommunications pathway shop drawings, the *Low Voltage* shall obtain the mechanical system shop drawings from the *General Contractor* and coordinate the telecommunications pathways with the mechanical systems installed above ceilings.

E. Test Reports:

1. Submit (2) Flash Drives of complete reports of all testing performed to the General Contractor two weeks prior to Turnover.
2. Provide proof of calibration of the network test equipment and permanent link adapters. Test results shall be provided in PDF and LinkWare software formats.
3. Include a final copy of the test reports on a Flash Drive.

F. As-Built Drawings:

1. A complete set of all electrical and telecommunications drawings shall be kept in the job-site office to show actual installation of cabling and equipment during construction.
2. The use of this set of drawings shall only be used for recording as-built conditions.
3. Where any material, equipment or system component is installed differently from that shown, the difference shall be indicated clearly and neatly using ink or indelible pencil in the color red during construction.
4. Prior to project completion, submit a complete, as constructed *As-Built* set of Drawings to the *General Contractor*.
5. At project completion, provide one complete set of the telecommunications As-Built Drawings to be stored in the *IT/Server Room.*
6. Provide an electronic copy of the *As-Built* drawings in full-size PDF and CAD format, on Flash Drive, in each O&M manual.

G. The Flash Drive in each O&M manual shall include test results, *As-Built*, and manufacturer warranty. The Flash Drive shall contain a folder index for each of the closeout submittals.

1.4 REFERENCE CODES AND STANDARDS

A. Installation Standards: Cable and equipment installation shall comply with the following standards. All publications must be of the latest issue and addenda:

1. NEC National Electric Code
2. ANSI/TIA-568-C.0: Generic Telecommunications Cabling for Customer Premises
3. ANSI/TIA-568-C.1: Commercial Building Telecommunications Cabling Standard Part 1: General Requirements
4. ANSI/TIA-568-C.2: Balanced Twisted-Pair Telecommunications Cabling and Components Standards
5. ANSI/TIA-568-C.3: Optical Fiber Cabling Components Standards
6. ANSI/TIA-569-B: Commercial Building Standard for Telecommunications Pathways and Spaces
7. ANSI/TIA-598-C: Optical Fiber Cable Color Coding
8. ANSI/TIA-606-A: The Administration Standard for the Telecommunications Infrastructure of Commercial Building
9. ANSI/TIA-J-STD-607-B: Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
10. ANSI/TIA-862-A: Building Automation Systems Cabling
11. ANSI/TIA/EIA-455-B: Standard Test Procedures for Fiber Optic Cables and Transducers, Sensors, Connecting and Terminating Devices, and other Fiber Optic Components
12. ANSI/TIA/EIA-604: Fiber Optic Connector Intermateability Standard
13. IEEE 802.3-2000 Ethernet Standard

B. Materials:

1. All materials shall be UL Listed and labels indicating so shall be affixed where labeling is normally visible.
2. Equipment shall be regularly catalogued items of the manufacturer and shall be supplied as a complete unit in accordance with the manufacturer's standard specifications with any optional items required for proper installation unless otherwise noted.
3. All telecommunications connectivity and cabling shall be independently tested to meet current TIA standards.
4. Material shall be delivered to the site in the original packing.

1.5 QUALIFICATIONS

A. The telecommunications work specified in this Section is acknowledged to require special skills mastered by education, experience, or both.

B. The *Low Voltage* contractor shall have direct access to all tools and test equipment required to complete the telecommunications work when the work is bid.

C. The *Low Voltage* contractor shall have a full time *RCDD* on staff to review all plans and installation during the construction phase of the project.

D. The *Low Voltage* contract must provide a full time *Project Manager* for single point of contact for the duration of the project

E. Provide the names of the *Low Voltage* contractor's personnel to be assigned to this project and the specific experience of each.

F. A minimum of 50% of the field technicians who will work independently at any given time during the project on the structured cabling system shall have a minimum of three years' experience on completed telecommunications projects of like magnitude and complexity. A minimum of 50% of the field technicians working at the job site shall have completed a copper technician installation training class conducted by the warranting manufacturer or BICSI. Technicians must hold a Bicsi Level 1, 2 & 3 Certification.

1.6 PRE-CONSTRUCTION MEETING

A. Pre-Installation Conference:
1. Schedule a conference a minimum of 10 calendar days prior to beginning work of this section.
2. Agenda: Clarify questions related to work to be performed, scheduling, and coordination.
3. Attendance: *Low Voltage* Contractor, *Contractor*, Architect, Owner's representatives, and other parties affected by work of this section.
4. *Contractor* will coordinate all scheduled meetings with the owner Project Manager.

PART 2– PRODUCTS

2.1 OVERVIEW

A Product Acceptability: The products section contains lists of acceptable products. If product substitutions are proposed, they must be made based upon a comparison of equivalence to the product specified. Considerations may include but shall not be limited to functional, physical, aesthetic and/or interface aspects. The *Structured Cabling* Engineer shall be the sole judge of whether or not a submitted substitution is deemed to be "equivalent" to that specified. Project consists of construction of building communication system including the Inside Wiring (IW) of video, voice and data circuits as well as telephone distribution cabling from MPOE to IDF.

**Note - If there is a discrepancy between this document and the Contract drawings the greater of the 2 will take precedence.*

2.2 EQUIPMENT, MATERIALS

A. General

1. Items noted "NIC" (Not in Contract) will be furnished and installed by owner or under separate contract.

2. *Low Voltage* Contractor is to install plenum rated *CAT6* cable for data

3. *Low Voltage* Contractor is to install plenum rated *RG6* (or RG11 based on distance) cable for video

4. *Low Voltage* Contractor is to install plenum rated *Micro-Duct* for future Fiber Installation

5. All cables for Surveillance, AV and data are to be appropriately labeled at each IDF

6. "Electrical Outlet" is to be provided by the *Electrical* contractor, for the ADP. The receptacle termination is to be the responsibility of the electrical contractor [NIC]

B. Office Area

1. Wall Phone Outlet

a. Wire with *one (1) plenum* rated *CAT6* cable from Telecom Room to Outlet

b. Jack Termination for *CAT6* cable on *White CAT6 RJ45* insert using 568B configuration

c. Faceplate is a *1-port white* wall plate with mounting lugs that will accommodate the above referenced insert

d. Telecom Room Termination for *CAT6* cable on *CAT6* Patch Panel

e. Mounted at 48" above finished floor (Unless otherwise noted)

f. Cable is to be labeled on both ends

g. Cable is to be tested from Telecom Room to outlet as defined herein

2. Temperature Monitor Sensor

    a. Wire with *one (1) plenum* rated *22/4* wire from Telecom Room to Outlet

    b. Jack Termination for 22/4 on *White CAT6 RJ45* insert using pins 3 thru 6

    c. Faceplate is a *1-port white* wall plate with mounting lugs that will accommodate the above referenced insert

    d. 22/4 wire will be left unterminated with 15' service loop on backboard

    e. Mounted at 48" above finished floor (Unless otherwise noted)

    f. Cable is to be labeled on both ends

3. Single Cable Outlet

    a. Wire with *one (1) plenum* rated *CAT6* cable from Telecom Room to Outlet

    b. Jack Termination for *CAT6* cable on *White CAT6 RJ45* insert using 568B configuration

    c. Faceplate is a *1-port white* wall plate that will accommodate the above referenced insert

    d. Telecom Room Termination for *CAT6* cable on *CAT6* Patch Panel

    e. Mounted at 18" above finished floor (Unless otherwise noted)

    f. Cable is to be labeled on both ends

    g. Cable is to be tested from Telecom Room to outlet as defined herein

4. Multiple Cable Outlet

    a. Wire with multiple *(X) plenum* rated *CAT6* cables from Telecom Room to Outlet

    b. Jack Termination for *CAT6* cable on *White CAT6 RJ45* inserts using 568B configuration

    c. Faceplate is a 4-*port white* wall plate that will accommodate the above referenced insert

    d. Telecom Room Termination for *CAT6* cable on *CAT6* Patch Panel

    e. Mounted at 18" above finished floor (Unless otherwise noted)

    f. Cables is to be labeled on both ends

    g. Cables is to be tested from Telecom Room to outlet as defined herein

5. Wireless Access Point Outlet

    a. Wire with *one (1) plenum* rated *CAT6* cable from Telecom Room to Outlet

    b. Jack Termination for *CAT6* cable in a *CAT6 Modular Plug* using 568B configuration

    c. Telecom Room Termination for *CAT6* cable on *CAT6* Patch Panel

    d. Refer Reflective Ceiling Plan for Mounting Height

e. Cable is to be labeled on both ends

f. Cable is to be tested from Telecom Room to outlet as defined herein

6. IP Camera Outlet

a. Wire with *one (1) plenum* rated *CAT6* cable from Telecom Room to Outlet

b. Jack Termination for *CAT6* cable on *White CAT6 RJ45* insert using 568B configuration

c. 2-*port* surface mount box that will accommodate the above referenced insert

d. Telecom Room Termination for *CAT6* cable on *CAT6* Patch Panel

e. Surface mount box will be mounted above ceiling.

f. Cable is to be labeled on both ends

g. Cable is to be tested from Telecom Room to outlet as defined herein

7. Multiple Cable Ceiling Outlet

a. Wire with multiple *(X) plenum* rated *CAT6* cables from Telecom Room to Outlet

b. Jack Termination for *CAT6* cable on *White CAT6 RJ45* insert using 568B configuration

c. 2-*port* surface mount box that will accommodate the above referenced insert

d. Telecom Room Termination for *CAT6* cable on *CAT6* Patch Panel

e. Surface mount box will be mounted above ceiling.

f. Cable is to be labeled on both ends

g. Cable is to be tested from Telecom Room to outlet as defined herein

8. Coax Outlet

a. Wire with *one (1) plenum* rated *RG6 (or RG11 based on distance)* cable from Telecom Room to Outlet

b. Jack Termination for *RG6* cable on *F-Connector* modular insert

c. Faceplate is a *1-port white* wall plate that will accommodate the above referenced insert

d. Telecom Room Termination for *RG6* will be with an *F-Connector* and then left coiled on backboard.

e. Mounted at 18” above finished floor (Unless otherwise noted)

f. Cable is to be labeled on both ends

g. Cable is to be tested from Telecom Room to outlet as defined herein

9. TV Location Outlet

a. Wire with *one (1) plenum* rated *RG6 (or RG11 based on distance)* and *(1) plenum* rated *CAT6* cable from Telecom Room to Outlet

b. Jack Termination for *CAT6* cable on *White CAT6 RJ45* inserts using 568B configuration and termination for *RG6* cable on *F-Connector* modular insert

c. Faceplate is a 2-*port white* wall plate that will accommodate the above referenced insert

d. Telecom Room Termination for *CAT6* cable on *CAT6* Patch Panel and Termination for *RG6* will be with an *F-Connector* and then left coiled on backboard.

e. Mounted at 54" above finished floor (Unless otherwise noted)

f. Cable is to be labeled on both ends

g. Cable is to be tested from Telecom Room to outlet as defined herein

10. Floor Box Location

a. Wire with *(x) plenum* rated *CAT6* cables from Telecom Room to Outlet

b. Jack Termination for *CAT6* cable on *White CAT6 RJ45* inserts using 568B configuration

c. 2-*port* 106-Adapterthat will accommodate the above referenced insert

d. Telecom Room Termination for *CAT6* cable on *CAT6* Patch Panel

e. 106-Adapter to be mounted in Floor Box provided by the EC

f. Cables is to be labeled on both ends

g. Cables is to be tested from Telecom Room to outlet as defined herein

C. Backbone Connectivity between IDF and MDF

1. Fiber Backbone

a. Install *one (1) 12-Strand OM3* riser rated, armored cable from MDF to IDFs

b. Terminate both ends on a 12-Port *LC* adapter panel

c. Adapter panel to be mounted in a 4u fiber enclosure in the MDF and a 1u fiber enclosure in the IDF

d. Fusion Splice LC pigtail connectors on both sides.

e. Fiber patch cords are to be provided for each location

f. Cables is to be labeled on both ends

g. Cables is to be tested from MDF to IDF as defined herein

2. Multi-Pair Copper Backbone

a. Install *one (1) CAT3 25-Pair* riser rate cables from MDF to IDFs

b. Telecom Room Termination for *CAT3 25-Pair* cable on *110-Termination Blocks*

c. Patch Cords are to be provided for each location

d. Cables is to be labeled on both ends

e. Cables is to be tested from Server Room to IDF as defined herein

D. Backbone Connectivity between MPOE and MDF

1. Fiber Backbone

a. Install *one (1) 24-Strand OM3* riser rated, armored cable from MDF on 2nd floor to MPOE on 1st floor

b. Terminate both ends on a 12-Port *LC* adapter panel

c. Adapter panel to be mounted in a 2u fiber enclosure in the MDF and a wall mounted lockable fiber enclosure in the MPOE

d. Fusion Splice LC pigtail connectors on both sides.

e. Fiber patch cords are to be provided for each location

f. Cables is to be labeled on both ends

g. Cables is to be tested from MDF to MPOE as defined herein

2. Copper Multi-Pair Backbone

a. Install *three (3) 50-pair CAT 3* riser rate cables from MPOE to MDF

b. Server Room Termination for *CAT3 50-Pair to be on 100 Pair 110-Termination Block on both ends*

c. Cables is to be labeled on both ends

d. Cables is to be tested from MDF to MPOE as defined herein

E. Patch Cords

1. Telecom Rooms

a. Install Patch Cords to make connection between patch panel and customer provided network switch.

b. Provide a mixture of 5' and 7' patch cords

2. Station Side

a. Provide 10' patch cords to connect equipment
b. Patch cords are to be left in the MDF for Customer IT to distribute around the property.

F. Cable Testing - Certification IS Required

1. Each cable from the Telecom Room to an outlet will be tested using an acceptable Level III tester.

a. Each *CAT6* cable will be tested for the following:

1) Perform telecommunications cabling inspection, verification, and performance tests in accordance with TINEIA-568-B.I and B.2.

2) Perform 250 MHz near end cross talk (NEXT) and attenuation tests for Category 6 systems installations.

3) Tests shall include wire map, length, attenuation, NEXT, PSNEXT, ELFEXT, PSELFEXT, RL and propagation delay.

4) Where applicable submit viewing software required to view reports.

5) Final test results shall include summary pages for each area as required.

6) Test results shall be provided in soft copy.

G. Miscellaneous

1. Do not use metal staples or other methods that kink or deform cable jacket. Use UL approved j-hooks spaced no more than 5' apart.

2. No splices are permitted.

3. All exposed connection hardware shall be protected from plaster, paint and other such materials. All coring and drilling through concrete block, stone, or other impervious materials are the responsibility of the contractor.

4. All fire stopping as required by code and installation is the responsibility of the installing contractor.

5. All low-voltage wiring should be run at least one stud bay apart (12" minimum) from any parallel high-voltage wiring, and cross at right angles whenever necessary. Where there is sufficient clearance to meet that requirement, the cabling must be arranged to provide the maximum possible separation, over as much distance as possible (under no circumstances shall the lateral distance be less than 4" without supplemental shielding). The only exception is where cables cross at right angles, where a 2" minimum separation must be maintained.

6. Coordinate with the electrical contractor before the high-voltage wiring commences.

7. Protecting cabling from damage is the responsibility of the low-voltage installing contractor. All cabling must be run where it is unlikely to be damaged after installation, nail plates should be installed where cabling passes through wall studs. Where steel framing is used, plastic bushings must be installed where ever cables pass through metal structural members. Cables must not touch any edges of metal framing.

8. All cabling must be properly supported and secured in a way that will not compress or deform the cables.

9. All cable bends must maintain manufactures bend radius requirements.

10. Any defective or damaged cabling, or any cable or cable installation that does not meet these specifications, must be replaced. This will be at the installation contractor's expense, unless it is the result of gross negligence by another trade. The general contractor shall be responsible for notifying the low-voltage installation contractor of any such cable damage. Splicing or repair of cabling is not permitted.

11. The low voltage contractor shall label all low voltage cables at both ends in a clear and legible manner. The label shall be located within 1 foot of the likely termination point after trim so that the label will not be cut off. Each label must be unique indicating origin and destination.

H. Materials and Equipment List

1. Horizontal Cabling

a. Cables

1) Television - RG6 or RG11 Dual Shield -plenum rated, (Siemon)

2) Data - *CAT6 250MHz* -plenum rated - 568B compliant (Siemon)

3) Fiber Optic Cable – *OM3* –plenum rated – Armored (Corning)

4) Multi-Pair Cable – *CAT3* –plenum rated (Superior Essex)

b. Faceplates

1) 1 port wall plate with mounting lugs (Siemon)

2) 2-port wall plate (Siemon)

3) 4-port wall plate (Siemon)

4) 2-port surface mount box (Siemon)

5) 4-port surface mount box (Siemon)

c. Connectors

1) *CAT6* RJ45 modular connector inserts (Siemon)

2) *LC* Connectors (Corning)

3) *RG6 or RG11* F-Type connector insets (Siemon)

2. Telecom Rooms

a. *CAT6* Termination

1) CAT6 Patch Panels (Siemon)

2) Coil with 10-foot service loop

b. *RG6/RG11* Termination

1) RG6 Dual F-Type connector compression

2) RG11 F-Type connector compression

3) Coil with 10-foot service loop

3. MPOE

    a. Cable

        1) Superior Essex CMR CAT3 premise copper PN varies per pair count

    b. CAT3 Termination

        1) 110-block frames, 110-blocks and 110-wiremanagers

4. Testing Equipment

    a. CAT6/ /RG6/RG11

        1) LEVEL IV / Ideal VDV multimedia cable tester kit PN 33-856 / Fluke CableIQ™

    b. CAT3

        1) Siemon 25 pair tester

        2) Siemon 25 pair test adaptors

PART 3 - EXECUTION

3.1 INSTALLATION

A Comply with manufacturer's instructions for installation of access doors.

3.2 INCLUSIONS:

A All labor and materials for a complete installation.

B All wire and cable to be run in conduit and open cable fashion and in accordance with National Electrical Code Standards.

3.3 EXCLUSIONS

A Power 110 and 208 power receptacles should be provided by the Electrical

Contractor

B Conduits and Cores

C Network PoE Switches

3.4 WARRANTY

A All components used in the installation of the system(s) will be new. The warranty period is for one (1) year from the date of installation. The warranty provides repair or replacement of all parts and labor on all workmanship and materials supplied by the system installer/contractor and its subcontractors. Vandalism, theft, misuse, intentional damage, acts of God, etc. are not covered by the warranty.

3.5 TRAINING, MANUALS and DRAWINGS

A The system installer shall provide a complete close out package including (3) sets of as-built drawings. Drawings shall include device locations, rack locations, conduit and wiring paths, support notes and relevant detail drawings.

B (3) Sets of installation and operating manuals for each product will be bound into book or binder format.

C (2) Thumb Drives containing all drawings, training manuals and warranties.

D The system shall provide a minimum of 4 hours training on all system functions and programming. The training shall be conducted over the course of 2 sessions:

1. System power-up and start-up.

2. Key Personnel

END OF SECTION 271000

SECTION 274000 – AUDIO VIDEO SYSTEMS

PART 1 – GENERAL

1.1 DISCRIPTION

A BASIC DEFINITIONS

1. Definitions:
   a. "Days": As used in the specifications, the word "days" means calendar days.
   b. "Provide": As used in the plans and specifications, the word "provide" means to furnish, install, connect, program, test, commission and warranty the subject material or services.

2. Specified Items – Substitutions
   a. "No Substitutes": The exact make and model number identified in the Specification shall be provided without exception. Where compatibility with existing systems is specified, and where a specific make or model number is not identified, the *Low Voltage* Contractor shall provide equipment which is compatible with, and equivalent to, existing equipment of the same description and type, and serving the same purpose.
   b. "Or Equal": An item may be substituted for the specified item provided that in every technical and aesthetic sense, the substituted item provides the same or better capability than the specified item, and is fully compatible with the new or existing systems specified. For expansion of existing systems, the item shall also be approved and fully supported by the existing system manufacturer. The *Structured Cabling* Engineer shall be the sole authority to determine the equality of substituted products with specified items.
   c. "Aesthetic", or "Aesthetic Considerations": If aesthetic considerations are involved in either the "or equal" or "approved equal" category, this shall be a consideration in approving or disapproving the proposed substitute. If the proposed substitute is aesthetically unacceptable to the Architect, then the specified, or another technically equal item, shall be provided.

3. "Beneficial Use": Each component of a system is not considered available for beneficial use until and unless all components and conditions have been fulfilled to make the system fully operational.

C DESCRIPTION

Section Includes: Installation, identification labeling and testing of connectivity and cabling.

1. Structured Telecommunications Cabling System Supporting:
   a. Data Networks
   b. Wireless Networks
   c. Fiber and Copper Backbone
2. Telecommunications Rooms and Spaces

1.2 AUDIO VISUAL SCOPE OF WORK

A. General:

1. Furnish all labor, materials, tools, equipment and services for the installation as indicated, in accordance with general provisions of specifications and the Contract Drawings.
2. Report percentage of work completed on a weekly basis.
3. Completely coordinate with work of all other trades for a complete and operational system.
4. Provide all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation, whether or not specifically indicated in the Contract Documents.
5. Floor penetrations, floor sleeves, conduit raceways, wall penetrations to be installed by electrical contractor
6. Provide labor and material for Video and Audio cabling with in the Conference, Meeting and multi-purpose rooms.

7. Provide labor and material for all overhead speakers
8. Provide labor and material for all Airplay Display locations.
16. Provide labor and material to build out the Server Room with all required AV Equipment.
17. Provide telecommunications bonding and ground to telecommunication grounding bus bar provided and installed by electrical contractor.

B. Provide complete installation of the Audio Visual including but not limited to:

1. Displays Monitors and Mounts
2. Projectors and Screens
3. Control Panel and systems
4. Speakers, amps and wire
5. Head end equipment for Local and remote AV Racks
6. Telecommunications bonding systems
7. Testing of the horizontal permanent link/qualifying cabling, and backbone cabling systems.
8. Patch Cords
9. Labeling and identification

C. Work and materials not included:

1. Wide Area Network equipment including routers, firewalls, modems and ASAs.
2. Local Area Network equipment including PoE switches.
3. Server hardware including application servers, Storage Area Network, application software and virtualization software.
4. Wireless LAN controllers, Access Points
5. Conduit
6. 120vac Outlets

1.3 SUBMITTALS

A. General: Bid documents, including plans, details and specifications are generally considered conceptual in nature, and provide direction on products and project requirements. In most cases, the Contractor is given a choice of products and methods that may be incorporated into the system. These choices may affect the overall design, configuration and installation of the proposed system.

B. All submittals shall be submitted at one time for approval. Partial submittals will not be considered.

C. Audio Visual Pre-Construction Submittal:

1. Submit in booklet form, with data arranged under basic categories, i.e., Certifications, Personnel Training, Manufacturer Warranty, Products, Test Equipment and Calibration, etc.
2. Submit (3) product submittal booklets.
3. Submittal shall include a typewritten index.
4. Submittal shall be organized by specification infrastructure component.
5. Submittal shall include dividers with identifying tabs between sections and references to section of the specifications.
6. Submit product data information sheets for approval and coordination with the item or model to be used clearly marked, showing ratings where appropriate.
7. Where more than one product is shown on a page, product shall be marked with an arrow or by other means to identify the exact product or products being submitted by specific part number.
8. Submittals shall be provided as one complete submittal. Partial submittals shall be rejected.
9. Submit the network test equipment including model number and serial number. Provide proof of calibration by the manufacturer.
10. Submit the resumes and certifications of all technicians and the project manager who will support this project. The certifications shall include:
    a. Copper and optical fiber installation certification
    b. Approved manufacturer classes satisfactorily completed

D. Pathway Shop Drawings:

1. Submit shop drawings of speaker cabling pathways, Conference and Meeting room Layouts with all conduit and power requirements. *Audio Visual* Contractor shall coordinate with *Contractor for coordination with other trades* prior to the submittal and start of installation.
2. Drawings shall identify quantity and size of all raceways, floor and wall penetrations and cable management equipment used to route and protect horizontal and backbone cabling.
3. Indicate pathway loading, and identify all cabling included in each pathway run by cable quantity.
4. Individual cabling runs shall be indicated similarly.
5. Workstation devices shall be labeled to provide identification of cabling being terminated in the telecommunications rooms and spaces.
6. Verify pathways for Category 6 data cables do not exceed the maximum cable length of 295 feet (90 meters).
7. All pathway shop drawings shall be generated using a CAD software program.
8. Submit shop drawings for approval and coordination.
9. Prior to submitting telecommunications pathway shop drawings, the *Audio Visual* shall obtain the mechanical system shop drawings from the *Contractor* and coordinate the telecommunications pathways with the mechanical systems installed above ceilings.

E. Test Reports:

1. Submit (2) Flash Drives of complete reports of all testing performed to the General Contractor two weeks prior to Turnover.
2. Provide proof of calibration of the network test equipment and permanent link adapters. Test results shall be provided in PDF and LinkWare software formats.
3. Include a final copy of the test reports on a Flash Drive.

F. As-Built Drawings:

1. A complete set of all electrical and telecommunications drawings shall be kept in the job-site office to show actual installation of cabling and equipment during construction.
2. The use of this set of drawings shall only be used for recording as-built conditions.
3. Where any material, equipment or system component is installed differently from that shown, the difference shall be indicated clearly and neatly using ink or indelible pencil in the color red during construction.
4. Prior to project completion, submit a complete, as constructed *As-Built* set of Drawings to the *Contractor*.
5. At project completion, provide one complete set of the telecommunications As-Built Drawings to be stored in the *IT/Server Room/Local AV Rack.*
6. Provide an electronic copy of the *As-Built* drawings in full-size PDF and CAD format, on Flash Drive, in each O&M manual.

G. The Flash Drive in each O&M manual shall include test results, *As-Built*, and manufacturer warranty. The Flash Drive shall contain a folder index for each of the closeout submittals. The label on each CD- ROM shall contain the Owner name; project site name and building identification number as applicable.

1.4 REFERENCE CODES AND STANDARDS

A. Installation Standards: Cable and equipment installation shall comply with the following standards. All publications must be of the latest issue and addenda:

1. NEC National Electric Code
2. ANSI/TIA-568-C.0: Generic Telecommunications Cabling for Customer Premises
3. ANSI/TIA-568-C.1: Commercial Building Telecommunications Cabling Standard Part 1: General Requirements
4. ANSI/TIA-568-C.2: Balanced Twisted-Pair Telecommunications Cabling and Components Standards
5. ANSI/TIA-568-C.3: Optical Fiber Cabling Components Standards
6. ANSI/TIA-569-B: Commercial Building Standard for Telecommunications Pathways and Spaces

7. ANSI/TIA-598-C: Optical Fiber Cable Color Coding
8. ANSI/TIA-606-A: The Administration Standard for the Telecommunications Infrastructure of Commercial Building
9. ANSI/TIA-J-STD-607-A: Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
10. ANSI/TIA-862-A: Building Automation Systems Cabling
11. ANSI/TIA/EIA-455-B: Standard Test Procedures for Fiber Optic Cables and Transducers, Sensors, Connecting and Terminating Devices, and other Fiber Optic Components
12. ANSI/TIA/EIA-604: Fiber Optic Connector Intermateability Standard
13. IEEE 802.3-2000 Ethernet Standard

B. Materials:
1. All materials shall be UL Listed and labels indicating so shall be affixed where labeling is normally visible.
2. Equipment shall be regularly catalogued items of the manufacturer and shall be supplied as a complete unit in accordance with the manufacturer's standard specifications with any optional items required for proper installation unless otherwise noted.
3. All telecommunications connectivity and cabling shall be independently tested to meet current TIA standards.
4. Material shall be delivered to the site in the original packing.

1.5 QUALIFICATIONS

A. The AV work specified in this Section is acknowledged to require special skills mastered by education, experience, or both.

B. The *Audio Visual* contractor shall have direct access to all tools and test equipment required to complete the telecommunications work when the work is bid.

C. The *Audio Visual* contractor shall have a CTS on staff to review all plans and installation during the construction phase of the project.

D. Provide the names of the *Audio Visual S*=contractor's personnel to be assigned to this project and the specific experience of each.

E. A minimum of 50% of the field technicians who will work independently at any given time during the project on the structured cabling system shall have a minimum of three years' experience on completed telecommunications projects of like magnitude and complexity. A minimum of 50% of the field technicians working at the job site shall have completed a copper technician installation training class conducted by the warranting manufacturer or InfoComm.

1.6 PRE-CONSTRUCTION MEETING

A. Pre-Installation Conference:
1. Schedule a conference a minimum of 10 calendar days prior to beginning work of this section.
2. Agenda: Clarify questions related to work to be performed, scheduling, and coordination.
3. Attendance: *Audio Visual* Contractor, *Contractor*, Architect, Owner's representatives, and other parties affected by work of this section.
4. *Contractor* will coordinate all scheduled meetings with the owner Project Manager.

PART 2– EQUIPMENT AND FUNCTION

2.1 Basis of Design

A. The following narrative is intended to help establish preliminary audiovisual system purpose, performance needs and conceptual functional requirements. The following manufacturers will be the basis for the design and integration of the Audiovisual systems:

- Crestron
- QSC
- Samsung
- NEC

- Da-Lite Screens
- Chief Mfg.

2.2 AV Systems Descriptions

A. Digital Si GeneTheory mpus – CP2
   1. The GeneTheory mpus will have a n GeneTheory active Digital Signage System that will be used for providing information pertinent to the GeneTheory mpus. This section describes the specifications required for the Digital Signage System AV equipment to be supplied, installed and configured by the Audio Visual Contractor that will be located in the Lobby:
   2. One Samsung DM75E 75" Full HD commercial grade LCD/LED display with integrated digital signage player, including a single Samsung MagicInfo Premium Server License, will be installed using a Chief Mfg. MSM1U wall mount, (1) TSI Touch TSI-DM75E-10IDOTGB Touch Screen Overlay For Samsung DM75E, USB Interface will be supplied and installed in order to provide an interactive touch interface for the room's DM75E.
   3. AV Contractor to include labor to program and design the layout and functions of the touch screen experience. Labor should include at least 5 meetings with stake holders and other key consultants.

B. IPad Registration, Lobby – CP2
   1. CP2 Lobby will require an iPad Registration area that will allow guest to check in for appointments and meetings.
   2. The system will notify staff members of their guest arrival as well as print a visitor badge that they will pick up from the reception desk.
   3. IPad kiosk should contain at least (2) iPads.
   4. Network connectivity will be provided by the wireless access system

C. Sound M GeneTheory econd Floor – CP1
   1. The GeneTheory mpus' CP1 Building, Second Floor, will have a Lencore sound masking system installed to cover all of the open office space areas. An RCP for this space will be provided to the Audio Visual Contractor for submittal to Lencore Acoustic's internal design team.

D. Audio and Video System, Training Room 127 –
   1. This section describes the specifications required for the Audio and Video System equipment to be supplied, installed and configured by the Audio Visual Contractor for Training Room 127:
   2. (1) NEC E805 80" commercial grade Full HD LCD/LED monitor will be installed using a Chief Mfg. LSM1U wall mount.
   3. An digital AV switching and control system comprised of (1) DMPS3-4K-300-C 3-Series 4K DigitalMedia Presentation System, (2) Crestron DM-TX-4K-100-C-1G wall/floor box mounted HDMI extender/transmitters, (1) DM-RMC-4K-100-C-1G, Wall Plate 4K DigitalMedia 8G+® receiver/room controller 100 and (1) Crestron CEN-SW-POE-5, 5-Port PoE switch.
   4. The audio amplification system will be comprised of (1) QSC SPA4-100 4 channel Energy Star certified audio power amplifier and (6) QSC AD-C6T two-way surface mounted loudspeakers.
   5. Prior to final programming, the AV contractor will meet with the client team to discuss the touch panel layout and design as well as detailed programming functionality in order to provide a fully integrated, easy to use, control system.
   6. All head end AV and control equipment will be housed in an 18 unit, stand-alone, floor standing equipment rack and will be protected by power conditioners that will be provided and installed by the Audio Visual Contractor.

E. Audio and Video System, Multipurpose Room 110 –
   1. This section describes the specifications required for the Audio/PA and Video System equipment to be supplied, installed and configured by the Audio Visual Contractor for Multipurpose Room 110:
   2. (4) NEC NP-PA653UL 6500-Lumen, WUXGA, professional laser installation projectors will be installed using Chief Mfg. ceiling mounts.
   3. (4) Da-Lite Tensioned Advantage Electrol 109"/16:10 projection screens, P/N 21805LS will be provided and installed.
   4. A digital AV matrix switching system comprised of (1) DM-MD16X16 16x16 DigitalMedia™ Switcher chassis populated with (11) DMC-4K-C-HDCP2 and (4) DMC-4K-HD-HDCP2 input cards, plus (2) DMC-4K-CO-HD-HDCP2 and (2) DMC-4K-HDO outputs cards as well as (11) Crestron DM-TX-4K-100-C-1G wall/floor box mounted HDMI extender will be supplied and installed.

5. A control system comprised of (3) Crestron TSW-760 7" touch screens, (1) Crestron CP3 3-Series Control System® and (1) Crestron CEN-SWPOE-16, 16-Port managed PoE switch will be supplied, installed and configured to provide a user interface for control of the AV system.
6. (1) QSC Core 110f Unified Core Audio DSP will be integrated with the AV matrix switching and control system in order to provide audio mixer/processor functions.
7. (3) Shure QLXD24/B58 series radio microphone systems will be supplied and integrated with the Core 110f. These microphones will be used for voice reinforcement during classes and events.
8. The audio amplification system will be comprised of (3) QSC SPA4-100 4 channel Energy Star certified audio power amplifiers, (32) QSC AD-C6T two-way ceiling mounted Loudspeakers.
9. Prior to final programming, the AV contractor will meet with the client team to discuss the touch panel layout and design as well as detailed programming functionality in order to provide a fully integrated, easy to use, control system.
10. All head end AV and control equipment will be housed in a 48 unit, stand-alone, floor standing equipment rack and will be protected by power conditioners that will be provided and installed by the Audio Visual Contractor.

F. Audio Video System, Small Conference Rooms (typical of 13 rooms)–
1. This section describes the specifications required for the Audio/Video system equipment to be supplied, installed and configured by the Audio Visual Contractor for the Small Conference Rooms:
2. One NEC E656 65" commercial grade Full HD LCD/LED display will be installed using (1) Chief Mfg. MSM1U wall mount.
3. An HDMI extender and control system comprised of (1) Crestron HD-EXT-USB-2000-C 4K HDMI® & USB over HDBaseT® Extender 2000 extender/receiver kit, (1) Crestron RMC3 room media controller and (1) Crestron CNX-B4 wall mounted designer keypad control interface will be supplied and installed.
4. (1) Extron Cable Cubby 700 series recessed table AV box with (1) retractable HDMI cable and (1) AC+USB 222 US AC+USB power module.
5. Prior to final programming, the AV contractor will meet with the client team to discuss the touch panel layout and design as well as detailed programming functionality in order to provide a fully integrated, easy to use, control system.

G. Audio Video System, Large Conference Rooms (typical of 4 rooms)–
1. This section describes the specifications required for the Audio/Video system equipment to be supplied, installed and configured by the Audio Visual Contractor for the Large Conference Rooms:
2. One NEC E805 80" commercial grade Full HD LCD/LED display will be installed using (1) Chief Mfg. LSM1U wall mount.
3. An HDMI extender and control system comprised of (1) Crestron HD-EXT-USB-2000-C 4K HDMI® & USB over HDBaseT® Extender 2000 extender/receiver kit, (1) Crestron RMC3 room media controller and (1) Crestron CNX-B4 wall mounted designer keypad control interface will be supplied and installed.
4. (1) Extron Cable Cubby 700 series recessed table AV box with (1) retractable HDMI cable and (1) AC+USB 222 US AC+USB power module.
5. Audio conferencing capabilities will be provided by an Owner Furnished audio conference telephone
6. Prior to final programming, the AV contractor will meet with the client team to discuss the touch panel layout and design as well as detailed programming functionality in order to provide a fully integrated, easy to use, control system.

2.3 Bulk Cables, Rack Cables, Connectors and Accessories

1. The AV contractor will provide the necessary bulk field and rack cables (CAT 5e, Shielded CAT6, Speaker Wire, Line Level Wire, HDMI, VGA, USB, etc) to connect all of the field devices and rack interconnects, as well as the necessary AV connectors, lacing bars, shelves, and other accessories to provide a fully connected AV system.

2.4 Miscellaneous

1. Do not use metal staples or other methods that kink or deform cable jacket. Use UL approved j-hooks spaced no more than 5' apart.

2. No splices are permitted.

3. All exposed connection hardware shall be protected from plaster, paint and other such materials.

4. All coring and drilling through concrete block, stone, or other impervious materials are the responsibility of the contractor.

5. All fire stopping as required by code and installation is the responsibility of the installing contractor.

6. All low-voltage wiring should be run at least one stud bay apart (12" minimum) from any parallel high-voltage wiring, and cross at right angles whenever necessary. Where there is sufficient clearance to meet that requirement, the cabling must be arranged to provide the maximum possible separation, over as much distance as possible (under no circumstances shall the lateral distance be less than 4" without supplemental shielding). The only exception is where cables cross at right angles, where a 2" minimum separation must be maintained.

7. Coordinate with the electrical contractor before the high-voltage wiring commences.

8. Protecting cabling from damage is the responsibility of the low-voltage installing contractor. All cabling must be run where it is unlikely to be damaged after installation, nail plates should be installed where cabling passes through wall studs. Where steel framing is used, plastic bushings must be installed where ever cables pass through metal structural members. Cables must not touch any edges of metal framing.

9. All cabling must be properly supported and secured in a way that will not compress or deform the cables.

10. All cable bends must maintain manufactures bend radius requirements.

11. Any defective or damaged cabling, or any cable or cable installation that does not meet these specifications, must be replaced. This will be at the installation contractor's expense, unless it is the result of gross negligence by another trade. The general contractor shall be responsible for notifying the low-voltage installation contractor of any such cable damage. Splicing or repair of cabling is not permitted.

12. The low voltage contractor shall label all low voltage cables at both ends in a clear and legible manner. The label shall be located within 1 foot of the likely termination point after trim so that the label will not be cut off. Each label must be unique indicating origin and destination.

PART 3 - EXECUTION

3.1 INSTALLATION

A Comply with manufacturer's instructions for installation of access doors.

3.2 INCLUSIONS:

A All labor and materials for a complete installation.

B All wire and cable to be run in conduit and open cable fashion and in accordance with National Electrical Code Standards.

3.3 EXCLUSIONS

A Dedicated 110 VAC outlets for Intrusion Alarm panels by the electrician

B Conduits and Cores

C Network PoE Switches

3.4 WARRANTY

A All components used in the installation of the system(s) will be new. The warranty period is for one (1) year from the date of installation. The warranty provides repair or replacement of all parts and labor on all workmanship and materials supplied by the system installer/contractor and its subcontractors. Vandalism, theft, misuse, intentional damage, acts of God, etc. are not covered

by the warranty.

3.5 TRAINING, MANUALS and DRAWINGS

A The system installer shall provide a complete close out package including (1) set of reproducible vellum as-built drawings and (3) sets of as-built blueprints. Drawings shall include device locations, controller locations, junction box locations, conduit and wiring paths, support notes and relevant detail drawings.

B (3) Sets of installation and operating manuals for each product will be bound into book or binder format.

C The system shall provide a minimum of 4 hours training on all system functions and programming. The training shall be conducted over the course of 2 sessions:
1. System power-up and start-up.
2. Key Personnel

END OF SECTION 274000

SECTION 275319 - WIRELESS DISTRIBUTED ANTENNA SYSTEM

GENERAL

1.1 SUMMARY

A. This Section includes an in-building wireless distributed radio system used for emergency responders, public safety communications, and law enforcement. The system shall be specific to those frequencies associated with public safety with no additional design required for other wireless services such as cellular telephone or wireless LAN distribution (IEEE 802.11).

B. The “antenna system” is defined to include, but is not limited to; headend equipment including bi-directional amplifiers, roof mounted donor antennae, power supplies and remote distribution components including coverage antennae, wiring/cabling, signal splitters and power dividers, and accessories for a complete system.

C. Delegated Design; The installer for the work of this section shall design, install, test, and certify a complete and fully operating “radio enhancement antenna system” in the project area as defined by the drawings and incompliance with Annex O to the Fire Code NFPA 1. Installer shall provide all site surveys, frequency coordination, and integration to any Owner provided equipment.

D. Related Sections include the following:

1.2 1. Division 01 Section “Construction Waste Management”

A. 2. Division 01 Section "Sustainable Design Requirements" for additional LEED requirements.

1.3 SYSTEM DESCRIPTION

A. General: System shall operate without causing interference to other parts of the public safety radio system. There shall be a 15-dB minimum isolation between donor and coverage antennae. Refer to the drawings for the building configuration, number of floors, overall square footage, construction types (combination of masonry and metal stud/gypsum board), and ceiling plenum conditions.

B. Radio Coverage: For critical areas, (command and control centers, fire pump rooms, exit stairwells and passageways, main lobby and elevator lobbies, standpipe valve locations, and other areas deemed critical by the AHJ) shall have 99% coverage. For general areas, the coverage shall be 90%.

C. Radio Frequency Bands: Provide radio enhancement for all the following:

D. 1. UHF frequencies:

E. a. 450 Mhz – 470 Mhz

b. 470 Mhz – 512 Mhz

F. Signal Strength: Provide a minimum of inbound and outbound signal strengths of -88 dBm.

G. System Components: System power/signal components, including bi-directional amplifiers, shall have FCC acceptance and must operate in accordance with commission rules, (FCC 47 CFR 90.219)

H. Power Supply: System requires a secondary battery power source. This power source shall be either a 12-hour battery backup for the system at 100% capacity if emergency generator power is not provided to the

system, or a storage battery source capable of at least two hours of operation at 100% capacity if emergency generator power is provided to the system.

I. System Monitoring: Provide an automatic monitoring system with local alarms for antenna malfunction, signal amplifier failure, and power supply monitoring including loss of AC, and battery “charge” status.

1.4 SUBMITTALS

A. Product Data: Include detailed manufacturer's specifications for each component specified. Include data on features, ratings, and performance.

B. Shop Drawings: For wireless antenna distribution system equipment, include plans, elevations, sections, details, and attachments to other Work.

1. Include dimensioned plan and elevation views of components and enclosures, and details of control panels. Show access and workspace requirements.
2. Plans drawn to scale and coordinating locations of antenna’s and radiating cable.
3. Location of items requiring installation coordination (where required) including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and other architectural features assuming reflective ceilings drawings were received.

C. Product Certificates: Signed by manufacturers of systems certifying that products furnished comply with requirements.

D. Installer Certificates: Provide manufacturer certification signed by manufacturer certifying that installers have been trained to install all components of the system and comply with manufacturer’s requirements.

E. Field Test Reports: Indicate and interpret test results for compliance with performance requirements of installed systems.

F. Maintenance Data: For wireless distribution system equipment and components to include in maintenance manuals specified in Division 1. In addition to requirements specified in Division 1, include the following:

1. Detailed operating instructions covering operation under both normal and abnormal conditions.
2. Routine maintenance requirements for system components.
3. Lists of spare parts and replacement components recommended being stored at the site for ready access.

G. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is an authorized representative of the wireless distribution system equipment manufacturer, for both installation and maintenance of units required for this Project, to supervise installation of the system.

B. Certified RF Design Engineer Qualifications: A certified RF engineer who is licensed with a valid FCC issued General Radio Operators License, and has certification of inbuilding system training issued by a nationally recognized organization or school or a certificate issued by the manufacturer of the equipment being installed.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 CODES AND STANDARDS

A. The work shall be performed by competent craftsmen skilled in the trade involved and shall be done in a manner consistent with normal industry standards. All work shall conform to all applicable sections of currently adopted editions of the codes and standards listed below or the codes, standards and specifications published by the organizations listed below:

1. National Fire Protection Association (NFPA 1, Annex O).

2. National Electrical Code (NEC), 2011 Edition.

3. International Fire Code (IFC, 2009), Section 510 and Appendix J.

4. National Electrical Manufacturer's Association (NEMA).

5. FCC Compliance, FCC 47 CFR 90.219 (2007)

B. Where there is a conflict between the code and the contract documents, the code shall have precedence only when it is more stringent than the contract documents. Items that are allowed by the code but are less stringent than those specified on the contract shall not be substituted.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: System components and equipment shall be rated for the environments where installed.

1.8 COORDINATION

A. Coordinate Work of this Section with the requirements of the local public safety agencies.

B. Coordinate layout and installation of wireless distribution system equipment, antennas, and radiating cable with other construction that penetrates ceilings or is supported by them, including but not limited to light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

C. Coordinate location of cabling and antennas with other trades.

D. Coordinate location of equipment in the telecommunications rooms and spaces with the Owner and the telecommunications installer.

1.9 WARRANTY

A. Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

1. Special Warranty for Wireless Distribution System and Components: Written warranty, signed by manufacturer and Installer agreeing to correct system deficiencies and replace components that fail in materials or workmanship within a two-year period when installed and used according to manufacturer's written instructions. This warranty shall be in addition to, and not limiting, other rights Owner may have under other provisions of the Contract Documents.

PART 2 - PRODUCTS

2.1 WIRELESS DISTRIBUTED ANTENNA SYSTEMS

A. Description: The distributed antenna system is an in-building wireless system for frequencies in the specified UHF ranges. Provide a separate distribution for the public safety frequencies listed above and not to be combined with other wireless services.

B. Components: The system uses a mix of radiating coaxial cable, non-radiating coaxial cable, broadband antennas, passive components, and connectors to distribute wireless services throughout the building.

C. Mount head end components (amplifiers, power supplies, etc.) in Equipment Rack in the Server Room on 3rd Floor.

D. Protect signal cables and connected components against transient-voltage surges by suppressors and absorbers designed specifically for the purpose in required areas.

2.2 SYSTEM COMPONENTS

A. The following components are listed, at a minimum, to define the types of components expected for the design of the in building wireless system. Dependent on the actual design provided by the installer, the following specifications are minimum requirements for the associated components.

B. Bi-Directional Amplifiers: Provide a dedicated amplifier designed for the specified frequencies and performance criteria listed above, with any required “rejection” filtering and/or technologies to mitigate interference from adjacent channels and to meet the antenna isolation issues. The amplifiers shall have the following features:

1. Frequency Range (as specified above)
2. Automatic Gain Control
3. Thermal management
4. Monitoring with Self Diagnostics and Alarm Notification
5. Serial Interface

C. Low Profile Broadband Log Periodic Antenna (Directional) and Broadband Omni Antenna:(Omni-Directional)

1. Frequency Range (MHz): 450 to 960.
2. Polarization: Vertical Linear.
3. Impedance: 50 ohms.
4. Interfaces: Female Type N connector.
5. Mounting: Pre-affixed bracket for bolting onto flat and non-metallic ceiling and wall structure. Must be able to mount above lay-in ceiling.
6. Radom must be rated to UL 94V0 Plenum standards for installation above ceiling in air plenum and above lay-in grid ceilings.

2.3 SIGNAL TRANSMISSION COMPONENTS

A. Radiating Cable:

1. Size: 1/2”

2. Nominal Impedance: 50-ohms.

3. Must be listed for use in air plenums.

B. Coaxial Cable:

1. Size: 7/8” or 1/2"

2. Nominal Impedance: 50-ohms.

3. Must be listed for use in plenums.

C. Connectors: N-Type connectors for coaxial cable.

D. Cable Hangers: “Click” Self-Locking Hangar or approved equal.

PART 3 - EXECUTION

3.1 DESIGN PROCESS

A. Perform on site survey to determine the RF landscape and potential interferences from existing radio frequencies in the area and structural obstructions to the building coverage as specified.

B. Meet with local agencies to verify exact project requirements.

C. The wireless distributed antenna system shall be designed in accordance with Sections J103.1.1 through J103.1.5 of the 2009 IFC, Appendix J.

D. Submit a narrative that shall indicate the performance of the system, including the requirements for coverage, and the frequencies supported.

E. Submit product specifications and information for all equipment, including but not limited to rooftop antennae, bi-directional amplifiers, secondary power supply systems, filters, cabling, and in-building antennae.

F. Submittal design/construction documents for the system shall be of sufficient clarity to indicate the location, nature and extent of the work proposed and show in detail that it will conform to the system specifications.

3.2 EXAMINATION

A. Examine pathway elements intended for cable. Check raceways, cables trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.

B. Examine roughing-in for antenna to verify actual locations of cable connections before antenna installation.

C. Examine walls, floors, roofs, equipment bases, and roof supports for suitable conditions where equipment is to be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

E. Provide detailed site survey to determine best routing cable and location of antenna.

3.3 COAXIAL CABLE INSTALLATION

A. All cable and antenna must be plenum rated when used in return air plenum areas.

B. Install surge suppressors where ac-power-operated devices are not protected against voltage transients by integral surge suppressors specified in UL 1449. Install surge suppressors at the devices' power-line terminals. Comply with Division 26 Sections.

C. Wiring Method: Install cables concealed in accessible ceilings. Install cables according to manufacturer's recommended installation practices using approved hangers at a minimum of every 5 feet.

D. Do not lay cable on suspended tile ceiling, ductwork, piping, conduit, or other building equipment.

E. Do not route radiating coaxial cable through metallic conduit or sleeve through a wall or partition. Transition to a non-radiating coax or jumper to pass through metal conduit or concrete.

F. Mount radiating coaxial cable a continuous minimum distance of 2 inches from any surface.

G. In order to minimize loss of RF signal due to shadowing, generally route radiating coaxial cable below the installed height of other infrastructure if within 2 feet of HVAC ductwork, metal pipes, sprinklers, pull boxes, unistrut, cable tray, or other cabling.

H. Wiring within Enclosures: Train cables to termination points with no excess.

I. Do not exceeding manufacturer's limitations on bending radii. The minimum installed bend radius of 1/2 inch radiating coax is 5 inches. The minimum routing bend radius of 7/8 inch radiating coax is 10 inches.

J. If cable (non-radiating coaxial cable) is to be installed in conduit, the bend radius of the conduit must be greater than 10 inches. If conduit bend radius is less than 10 inches, the coaxial cable must be terminated (connectorized) prior to pulling through conduit and a jumper must be used for routing through conduit.

K. Pulling Cable: Do not exceed manufacturer's recommended pulling tensions. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.

L. Exposed Cable: Install parallel to building lines, follow surface contours, and support the cable according to manufacturer's written instructions. Do not run adjacent and parallel to power or data cables.

M. Grounding: Provide independent signal circuit grounding recommended by manufacturer.

3.4 IDENTIFICATION

A. General Label Requirements:

1. Mechanically print and install all labels.

2. Format: Select font size to be readable and to fit all information required without overlap text.

3. Use all capital letters.

4. Clean all surfaces prior to attachment of any label. Follow manufacturer's recommendations for cleaning and affixing labels.

B. Coaxial Cable:

1. Label Location: Within 4 inches of each termination and tap.

2. Label Information: Cable number and “radiating coaxial cable. Do not disturb”. Follow detail drawings.

3. Method: Brady cable labels appropriately sized or approved equal.

3.5 ACCEPTANCE TEST PROCEDURE

A. The system shall be tested, upon completion of the installation, to ensure that two-way coverage on each floor of the building shall be as specified.

B. The test procedure shall be conducted in accordance with Section J103.2.4 of the 2009 IFC, appendix J.

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, and supervise pre-testing, testing, and adjusting of equipment.

B. Inspection: Verify that units and controls are properly installed, connected, and labeled and that interconnecting wires and terminals are identified.

3.7 CLEANING

A. Clean installed items using methods and materials recommended by manufacturer.

B. Clean system components, including antennas and supports, electronic equipment, and distribution components.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain equipment.

1. Train Owner's maintenance personnel on procedures and schedules for troubleshooting, servicing, and maintaining equipment.
2. Demonstrate methods of determining optimum alignment and adjustment of components and settings for system controls.
3. Review data in maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data" or Division 26 Section “General Electrical Requirements.”
4. Schedule training with Owner, through Architect/Engineer, with at least seven days’ advance notice.
5. Conduct a minimum of 4 hours training as specified in instructions to Owner's employees in Division 1 Section "Contract Closeout" or Division 26 Section “General Electrical Requirements.”

3.9 RECORD DRAWINGS

A. Maintain current documents at the construction site. Submit with Operation and Maintenance manuals.

B. Include all information required for shop drawings.

C. Include revisions to construction documents (addenda and field changes).

D.

END OF SECTION 275319

SECTION 283100 – FIRE DETECTION AND ALARM (DEFERRED APPROVAL)

PART 1 - GENERAL

1.1 GENERAL AND SPECIAL CONDITIONS

A. General and special conditions apply to the work in this section.

B. The Contractor shall furnish all equipment, materials, tools, labor, engineering, drawings, etc. necessary for a complete fire alarm system installation and renovation, with said systems being made ready for operation in accordance with the requirements of the Authorities Having Jurisdiction. The purpose of Owner furnished specifications is to convey to the Contractor the scope of work required, all of which the Contractor is responsible to furnish, install, adjust, and make operable. The omission by the Owner of any necessary system component as required by the Authorities Having Jurisdiction, in the specifications shall not relieve the Contractor of the responsibility for providing such necessity, without additional cost to the Owner. The Contractor shall visit the site before submitting his bid and shall examine all existing physical conditions that may be material to the performance of his work. No extra payments will be allowed to the Contractor as a result of extra work made necessary by his failure to do so. Any case of error, omission, discrepancy or lack of clarity shall be promptly identified to the Owner and Engineer for clarification prior to the bid due date.

C. The Contractor shall provide all devices and equipment required by these specifications and shown on the drawings. Under no circumstances will the Contractor delete any equipment or devices without the written directive of the Owner.

D. The fire detection and alarm system is part of a “Deferred Approval.” Coordinate with Section 013300 “Submittal Procedures” and with the requirements for deferred approvals indicated on the title sheet of the drawings.

1.2 RELATED DOCUMENTS

A. Section "Door Hardware”.

B. Section “Electrical”.

C. Section “Mechanical”

D. Section “Elevator”.

E. Smoke Control System Rational Analysis

1.3 CODES AND STANDARDS:

A. California Building Standards Administrative Code, 2016 Edition

B. California Building Code (CBC), 2016 Edition.

C. California Fire Code (CFC), 2016 Edition.

D. California Electric Code (CEC), 2016 Edition.

E. California Mechanical Code (CMC), 2016 Edition

F. GeneThe Fire Department Policies.

G. National Fire Protection Association (NFPA) 70 – *“National Electrical Code,”* 2014 Edition.

H. National Fire Protection Association (NFPA) 72 – *“National Fire Alarm and Signaling Code,”* 2016 Edition.

I. National Fire Protection Association (NFPA) 13 – “*Standard for the Installation of Sprinkler Systems*,” 2016 Edition.

J. National Fire Protection Association (NFPA) 170 – "*Standard for Fire Safety and Emergency Symbols*," 2015 Edition

1.4 SYSTEM ABBREVIATIONS AND DEFINITIONS

A. AHJ – Authority Having Jurisdiction (GeneThe Fire Department)

B. Approved – Unless otherwise stated, materials, equipment or submittals approved by the Owner, Engineer, or AHJ

C. ANSI – American National Standards Institute

D. CEC – California Electrical Code

E. Concealed – Where used in connection with installation of piping or conduit and accessories, shall mean, "Hidden from sight" as in shafts, furred spaces, in soffits or above suspended ceilings

F. Contractor – The Company awarded the prime contract for this work and any of its subcontractors, vendors, suppliers, or fabricators

G. DACT– Digital Alarm Communicator Transmitter

H. Engineer – Jensen

I. Exposed – Where used in connection with installation of piping or conduit and accessories shall mean "visible" or "not concealed"

J. FACP – Fire Alarm Control Panel

K. FAPS – Fire Alarm Power Supply

L. FM – Factory Global

M. FANN – Fire Alarm Annunciator

N. IDC – Initiating Circuit

O. Listed – Materials or equipment included in a list published by a nationally recognized laboratory that maintains periodic inspection of production of listed equipment and material, and whose listing states either that the equipment or materials meets nationally recognized standards or has been tested and found suitable for use in a specified manner

P. NFPA – National Fire Protection Association

Q. NAC – Notification Appliance Circuit

R. Owner – GeneTheory

S. UL – Underwriters Laboratories, Inc.

T. WACT – Wireless Alarm Communicator Transmitter (IP Based Data Network)

U. XPS – Auxiliary Power Supply

1.5 SYSTEM DESCRIPTION

A. Design requirements. The System supplied under this specification shall utilize node-to-node, direct wired, multi priority peer-to-peer network operations. The system shall utilize independently addressed, input/output modules, as described in this specification. Each panel shall be an equal, active functional member of the network, which is capable of making all local decisions and generating network tasks to other panels in the event of panel failure or communications failure between panels. The new work shall consist of the following:

1. New fire alarm control panels for the building as required.
2. New firefighter's smoke control panel for the building.
3. Off-site transmission for fire department notification by DACT and WACT to a U.L. Central/Remote station.
4. FAPS booster power supplies distributed throughout the facility to provide the power necessary for notification appliances.
5. Manual pull stations at exits.
6. Area smoke detection as required.
7. Beam smoke detection as required.
8. Area heat detection as required.
9. Duct smoke detection on HVAC units as required.
10. Addressable monitoring connections on all waterflow and valve supervisory switches.
11. Addressable monitor connections to special fire suppression systems where required.
12. Addressable monitor connections to smoke control systems where required.
13. Addressable control relay connections for the following equipment, devices, and hardware:
    a. Door/shutter release/open.
    b. Auto-door by-pass.
    c. Fan stops.
    d. Fire/smoke damper release.
    e. Elevator Recall.
    f. Smoke control equipment.
14. Synchronized alarm notification activation.
15. Class X/A network circuits.
16. Class B signaling line circuits.
17. Class B fire alarm and supervisory alarm initiating device circuits.
18. Class B notification appliance circuits.
19. UL/FM Approved, non-combustible fire stopping materials at all fire alarm conduit penetrations of fire resistance rated construction.
20. Installation of dedicated electrical circuits to fire alarm control panels and power supplies.
21. Coordination with other trades for the interface of alarm initiating, control, and supervisory connections of the fire suppression system, smoke control system, door/shutter release/open, elevator recall, and auto-door by-pass.
22. Shop drawings.
23. Two (2) sets of printed operating instructions and PDFs.
24. As-built drawings.

25. On-site project supervision.

26. Required, testing forms in accordance with NFPA 72 requirements.

27. Three-year manufacturer's warranty on all materials.

28. One-year Contractor's warranty on labor and miscellaneous materials.

B. Performance requirements. The addressable fire alarm and supervisory system shall perform the following functions:

1. Continuous monitoring of the status of all fire alarm and supervisory signal initiating devices.

2. Continuous monitoring of all electrically supervised fire alarm notification appliance circuits.

3. Operation of all required HVAC controls.

4. Operation of all required smoke control system controls.

5. Operation of magnetic door holders, smoke control make-up air doors, fire shutters, fire/smoke dampers, and elevator recall.

6. Alarm auto-doors bypass.

7. Activate audible and visual status change indicators and display the system point number, point description, and message associated with the point on the system's operator terminal(s).

8. Transmit alarm, trouble, and supervisory signals to the central station.

1.6 EXISTING CONDITIONS

A. Inspect and examine site conditions before submitting the proposal. Note the location of any existing conditions, omissions, or problems with the design documents that may impact the timely completion of the project. Immediately contact the Owner indicating any and all discrepancies in writing. Failure to do so will not relieve the Contractor of the obligations of the Contract.

B. Visit the site or premises in order to become familiar with job conditions. No extra charges will be allowed for work that could have been foreseen by an examination of the site or premises.

C. Adjust work to meet actual conditions existing at the job.

1.7 BASE BID

A. The Base Bid price shall include the total cost, including all required parts, equipment, programming, and associated labor to provide all work identified in the specification and required by applicable codes and standards.

1.8 SUBMITTALS.

A. Permit submittal documents, including drawings and equipment data sheets will be prepared and submitted to the AHJ for approval by the Contractor as part of a "Deferred Approval". The Contractor shall use the bid documents to assist in the preparation of the drawings. The Contractor may deviate from the layout shown on these drawings, as needed for project coordination and/or conditions. Any deviations shall be submitted to the Owner and Engineer for approval prior to submittal to the AHJ and field installation.

B. Coordination Drawings

1. Submit three sets of complete shop drawings and three sets of manufacturer's data sheets to the Owner and the Engineer for all necessary reviews prior to submittal to the AHJ and fabrication of materials.

1.9 QUALITY ASSURANCE

A. The fire alarm system manufacturer shall maintain a fully staffed branch office including application engineers, drafters, technical service personnel, and programmers capable of responding within 4 hours within the ƷeneThe area.

B. All technical service personnel shall be certified and trained by the fire alarm system manufacturer.

C. All electrical installation of the fire alarm system, including wire installation and terminations, shall be performed by the electricians in the employ of the installing Contractor.

D. All materials shall be UL listed or FM approved for their intended use.

E. State building codes, and local fire department requirements shall apply.

F. Similar materials shall be from a single manufacturer.

1.10 STORAGE/HANDLING

A. Storage of Materials, Equipment, and Fixtures: Contractor shall be responsible for storage and security of materials on job site, including furnishing of any storage facilities or structures required.

B. Handling Materials and Equipment: Contractor shall be responsible for on-site handling of materials and equipment scheduling.

C. The existing facility provides seven day 24-hour care. Contractor shall coordinate all construction operations with the Owner and their staff.

D. Contractor shall provide written requests a minimum of 72 hours in advance for any construction operations or shutdowns that will affect normal operation of the facility.

E. Maintain the premises free from accumulation of waste materials or rubbish caused by this work at all times to the Owner's standard for cleanliness. Finished flooring shall be protected from damage and continuous cleanup will be the responsibility of the Contractor.

F. At the completion of each workday, or when work in a defined area has been completed, remove all surplus materials, tools, etc. and leave the premises clean to the Owner's standard of cleanliness.

G. Remove all non-functional fire alarm equipment and wiring. All finished surfaces where existing equipment has been removed shall be patched and painted to match surrounding finishes.

H. The Contractor is responsible for replacing all removed ceiling tiles at the end of each workday. No tiles are to be left open unless prior approval has been received from the owner.

I. The Contractor will be responsible for replacing any ceiling tiles damaged during the prosecution of work. All replaced ceiling tiles shall match surrounding tiles.

1.11 PRODUCT DELIVERY

A. Delivery of Materials: Delivery of all materials and equipment to the job site shall be scheduled to assure compliance with the predetermined construction schedules.

1.12 WARRANTY

A. The manufacturer shall warranty all materials for a period of three years beginning with the date of final acceptance of the entire project by the Owner.

B. The Contractor shall warranty all miscellaneous materials and workmanship for a period of one year beginning with the date of final acceptance of the entire project by the owner. The Contractor shall be responsible during the installation, testing and warranty periods for any damage caused by his (or his subcontractors') work, materials, or equipment.

C. The Contractor shall provide a one-year written warranty against defects in material and workmanship furnished under this Contract. The costs of such warranty shall be part of the purchase price. The warranty commences upon substantial completion as defined in the Agreement.

D. The warranty shall include all necessary material, travel, labor, and parts to replace defective components or materials at the job site. The Contractor shall commence repair of any "in warranty" defects within 24 hours of notification of such defects.

E. The Contractor shall make allowances in his warranty to cover diagnosis of system defects that might ultimately be the responsibility of others to correct. When this occurs, the Owner's Representative and other affected trades shall be notified.

F. The warranty shall include all necessary factory and field software required to perform the specified tasks.

1.13 COMMISSIONING

A. A fire alarm acceptance test shall be coordinated with the Owner and the Owner's Representative. A letter certifying that the installation is complete and fully operational shall be forwarded to the Owner and the Owner's Representative.

B. The Contractor, the Owner's Representative, the GeneThe Fire Department, and an authorized representative from the supplier of equipment shall be in attendance at the final acceptance test. The final test shall include, but not be limited to the following:

1. A test of the complete system for grounded, open, and shorted circuits.

2. A test of each alarm-initiating device for functions specified and for the required alarm actions.

3. A test of the system for electrical supervision.

4. A test to verify that the emergency power source is capable of operating the system for specified periods.

5. A test to verify that alarm signals will operate under specified trouble conditions.

6. A test to verify that the system will perform all specified tasks.

PART 2 - MATERIALS

2.1 GENERAL

A. All components shall be used in accordance with the manufacturer's recommendations and its UL listing and/or FM approval.

B. Manufacturer for this project shall Edwards.

C. The substitutions of materials or products other than those named in the specifications are subject to proper approval of the Owner granted in writing.

2.2 CONTROL EQUIPMENT

A. Fire Alarm Control Panel.

1. The fire alarm control panel (FACP) shall have seismic certification for wall-mounting. The FACP shall be equipped with locked enclosures having removable access panels for servicing of electronic components. The FACP shall be completely pre-wired requiring only the connection of incoming field wiring and the plugging in of accessory modules such as additional memory, printer interface boards, etc. All controls and displays shall be mounted at heights allowing easy accessibility. The FACP shall include, but not be limited to, the following major components, some of which may be physically separate from the main cabinet:

a. Central processing equipment (CPU).

b. Operating terminal (OPT).

c. Data transmission equipment.

d. Mass data storage.

e. Primary AC power supplies.

f. Secondary power supplies.

g. DACT and WACT equipment.

2. The fire alarm control panel shall be installed in the Fire Panel Room.

3. The central processing unit (CPU) shall be UL listed for fire alarm use. The main memory system shall be adequately sized to provide display, printout, and control of 125% of the actual alarm and command points as described herein and indicated on the drawings. All basic alarm and control software shall be included. The CPU shall be completely field programmable and all data entered shall reside in the system.

4. The CPU shall be equipped with a non-volatile memory system.

5. Normal operating power for the FACP shall be a dedicated 120 VAC, single-phase, 60 Hz circuit supplied from the building electrical distribution power panel. Power supply circuit shall be dedicated to the FACP. In addition, the FACP shall be provided with surge protection and a battery standby power system, which shall operate the system for 24 hours in the standby mode.

6. The system-operating terminals (LCD) shall include, at a minimum, control function keys, digital display window programming keys, and key-operated lockout capability. The time shall be permanently displayed on the LCD and shall be visible at all times. The LCD shall allow the operator to perform the following minimum tasks:

a. Inquire point status.

b. Start or stop equipment manually.

c. Test and reset equipment manually.

d. Bypass system functions or features during manual system tests.

e. Initiate control event sequences.

f. Manually request “logs” of system status.

g. Acknowledge status changes.

h. Silence audible signals.

7. The FACP shall supervise each individual device on a signaling line circuit such that trouble, normal, alarm, and supervisory outputs are individually annunciated. Provide a minimum of 25% expansion per circuit.

8. It shall be possible to command, test, alarm reset, and alarm silence from the FACP.

B. Local Fire Alarm Annunciator

1. Local fire alarm annunciator (FANN) shall be located as required. The FANN shall be completely pre-wired requiring only the connection of incoming field wiring. All controls and displays shall be mounted at heights allowing easy accessibility.

2. The system status display shall consist of a LED/LCD display, microphone, and controls for the FACP.

C. Remote Fire Alarm Power Units.

1. The remote fire alarm power units (FAPS) shall have OSHPD seismic certification for wall-mounting and `be wall-mounted in locations as required. The FAPS shall be completely pre-wired requiring only the connection of incoming field wiring. The FAPS shall be mounted at heights allowing easy accessibility. The FAPS shall provide notification appliance synchronized 24VDC power. Normal operating power for the FAPS shall be a dedicated 120 VAC, single-phase, 60 Hz supplied from the building electrical circuits. Power supply circuit shall be dedicated to the FAPS. Transfer from normal to standby power or restoration of normal power shall be automatic. The FAPS shall be provided with surge protection and secondary battery standby, which shall operate the system for 24 hours in the standby mode.

D. Auxiliary Fire Alarm Power Supplies (XPS).

1. The auxiliary fire alarm power supplies (XPS) shall be wall-mounted in locations as required. The XPS shall be completely pre-wired requiring only the connection of incoming field wiring. The XPS shall be mounted at heights allowing easy accessibility.

2. Normal operating power for the XPS shall be a dedicated 120 VAC, single-phase, 60 Hz supplied from the building electrical circuits. Power supply shall be dedicated to the XPS. Transfer from normal to standby power or restoration of normal power shall be automatic. The XPS shall be provided with surge protection and secondary battery standby, which shall maintain the connected load during the loss of primary power for 24 hours.

2.3 ALARM/SUPERVISORY INITIATING DEVICES

A. Manual Pull Stations (Interior)

1. Manual fire alarm stations shall be provided as required. The manual fire alarm stations shall be Lexan red with raised lettering. Manual fire alarm stations shall be double-action. Operation of a manual fire alarm station shall cause its contacts to lock-in until manually reset and visually indicate an actuation (i.e., illuminated LED). Each station shall send an individual address to the fire alarm control panel.

B. Manual Pull Stations (Exterior)

1. Manual fire alarm stations shall be provided as required. The manual fire alarm stations shall be red plated surface to inhibit corrosion. Manual fire alarm stations shall be single-action. Operation of a manual fire alarm station shall cause its contacts to lock-in until manually reset. Each station shall send an individual address to the fire alarm control panel.

C. Waterflow Switches

1. Waterflow switches shall be wired and adjusted by the alarm contractor. The switch shall actuate within 90 seconds after the inspector's test valve is opened. Initial setting of waterflow switch activation shall be 45 seconds. Addressable point monitoring devices shall be provided to monitor waterflow switches and control valve tamper switches. The wiring from the monitored device to the point-monitoring device shall be a Class B electrically supervised circuit. The point monitoring device shall send an individual address to the fire alarm control panel.

D. Photoelectric Smoke Detectors

1. Photoelectric smoke detectors shall be provided as required. The detectors shall be provided with integral LEDs to indicate detectors in alarm. The detectors shall operate on the SLC. Concealed detectors shall have a remote indicator light or LED.

2. Duct-mounted smoke detectors shall be provided as required. The duct detectors shall be provided with approved duct housings mounted on the exterior of the duct, and shall have perforated sampling tubes extended across the width of the duct. Provide addressable relays for fan shutdown and control. The smoke detector shall send an individual address to the fire alarm control panel. Provide Key-activated Remote Test station w/ integral remote alarm indicator.

E. Projected Beam Smoke Detectors

1. Projected beam smoke detectors shall be provided as required for activation of the smoke control system. The detectors shall be provided with integral LEDs to indicate detectors in alarm. The detectors shall operate on the SLC. Detectors shall have multiple sensitivity settings in order to meet UL listings for the different distances covered by the beam.

F. Heat Detectors

1. The heat detectors shall be provided as required. The heat detectors shall be combination fixed temperature and rate-of-rise. The heat detectors shall be self-restoring and contain an integral LED to indicate detectors in alarm. The detectors shall operate on the SLC. The detector shall send an individual address to the fire alarm control panel.

G. Fire Suppression Systems

1. Fire suppression system control panels (Kitchen Hood, Clean Agent, Gaseous, Pre-action, etc.) shall be monitored for alarm, trouble, and supervisory status. Addressable point monitoring devices shall be provided to monitor the contacts. The wiring from the monitored contact to the point-monitoring device shall be a Class B electrically supervised circuit. The contact-monitoring device shall send an individual address to the fire alarm control panel.

H. Smoke Control Systems

1. Firefighter's smoke control system control panels shall be monitored for alarm, trouble, and supervisory status. Addressable point monitoring devices shall be provided to monitor the contacts. The wiring from the monitored contact to the point-monitoring device shall be a Class B electrically supervised circuit. The contact-monitoring device shall send an individual address to the fire alarm control panel.

I. Control Valve Supervisory Devices

1. Control valve supervisory switches will be provided by the Fire Protection Contractor but wired and adjusted under this section by the alarm contractor. Control valve tamper switches shall indicate an off-normal signal during the first two revolutions of the hand wheel or during one-fifth of the travel distance of the valve control apparatus from its normal position. The wiring from the monitored device to the point-monitoring device shall be a Class B electrically supervised circuit. The point monitoring device shall send an individual address to the fire alarm control panel.

J. Synchronized Notification Alarm Appliances

1. Synchronized visual alarm appliances shall be provided as shown on the drawings. The visual alarm appliances shall contain a strobe light source and clear lens. Standard finish shall be white with the word "FIRE" imprinted on the appliance. All visual appliances shall operate on 24 VDC polarized power to allow for supervision. Visual appliances shall be in accordance with the NFPA and UL Standard 1971. All visual appliances shall be mounted in accordance with NFPA 72.

K. Synchronized Combination Audible/Visual Alarm Appliances

1. Synchronized combination audible/visual alarm appliances shall be provided as shown on the drawings. Sound level shall be clearly heard 15 dB above ambient sound level in all normally occupied areas Standard finish shall be white with the word "FIRE" imprinted on the appliance. All audible/visual appliances shall operate on 24 VDC. Audible/visual appliances shall be in accordance with UL Standard 1971. All appliances shall be mounted in accordance with NFPA 72.

L. Audible Alarm Appliances

1. Audible alarm appliances shall be provided as shown on the drawings. Sound level shall be clearly heard 15 dB above ambient sound level in all normally occupied areas Standard finish shall be white with the word "FIRE" imprinted on the appliance.

2.4 ADDRESSABLE RELAY CONTROL DEVICES.

A. Provide control relays/contacts for fan shutdown, and control of fire/smoke dampers. The control relays/contacts shall be provided with number of contacts as required and housed in weather-tight metal enclosure. The contacts shall be rated as required for continuous duty.

B. Provide control relays/contacts for magnetic door and fire shutter release.

C. Provide control relays/contacts for auto-door by-pass.

D. Provide control relays/contacts for smoke control system make-up air doors.

E. Provide control relays/contacts for activation of smoke control system fans.

F. Provide control relays/contacts for elevator recall.

G. Addressable relay control devices shall be used to provide all required control functions. Control relays shall be located within 3 feet of the controlled device.

2.5 ADDRESSABLE SYCHRONIZATION OUTPUT MODULES.

A. Provide synchronized output modules for supervised alarm strobe circuits throughout the building.

2.6 DEVICE LABELING.

A. Provide labeling on each addressable device indicating address corresponding to the address indicated on the display indicated on the FACPs.

PART 3 - EXECUTION (REFER TO OWNER'S CRITERIA)

3.1 SYSTEM INSTALLATION

A. The alarm contractor shall furnish on-the-job supervision for the proper installation of devices in cooperation with other trades as may be required. This supervision shall include the following:

1. Specific on-site instructions to others on mounting and installation of each type of device by physically observing the mounting of one or more of each type of device, as required, assuring that the installer is properly instructed in the work.

2. Supervision as required by others to properly perform alarm installation work.

3. A complete test of the system, certifying that all devices have been activated and that the devices and systems have performed in accordance with the requirements of this specification.

4. Install, test, troubleshoot, and correct all system software provided under this specification. This includes, but is not limited to, actual keyboard entry, reprogramming required to meet this specification, and any other tasks associated with the system software.

5. Attend other related testing, which involves the operation of the fire alarm control panel.

B. All work shall be installed or relocated as indicated on the AHJ approved drawings and in accordance with the manufacturer. The drawings depict locations of equipment and devices. Exact routing of conduits shall be determined in the field by the installing contractor to suit conditions. All changes shall be clearly indicated on the record as-built drawings. The contractor shall update the as-built drawings daily with job progress reports.

1. Control Panels.

a. The control panel and its components shall be mounted so that no part of the enclosing cabinet is less than 12 inches or more than 78 inches above the finished floor. All manually operable controls shall be at least three feet and less than five feet above the finished floor. Panel shall be installed to comply with the requirements of UL 864.

2. Smoke Detectors.

a. Spot type smoke detectors shall be mounted on the ceiling or, if on a side wall, between the ceiling and 12 inches (300 mm) down from the ceiling to the top of the detector.

b. Smoke detectors shall be located at least three feet from diffusers of air handling systems.

3. Projected Beam Smoke Detectors.

a. Projected beam smoke detectors shall be installed in accordance with NFPA 72 and as required for proper activation of the smoke control system.

4. Heat Detectors.

a. Heat detectors shall be mounted on the ceiling not less than 4 inches (100 mm) from the side wall to the near edge, or if side wall, between 4 inches (100 mm) and 12 inches (300 mm) down from the ceiling to the top of the detector.

5. Visual Signal Appliances.

   a. Visual signal appliances shall be installed in accordance with NFPA 72.

   b. Wall mounted visual signal appliances shall be wall mounted such that the entire lens is not less than 80 inches and not greater than 96 inches above the finished floor.

   c. Ceiling mounted visual signal appliances shall be mounted in accordance with NFPA 72.

6. Audible Signal Appliances.

   a. Where ceiling heights permit, wall-mounted appliances shall have their tops at not less than 90 inches above the finished floor and 6 inches below the ceiling. Ceiling mounted audible signal appliances shall be mounted in accordance with NFPA 72.

7. Combination Audible/Visual Signal Appliances.

   a. The location of combination audible/visual signal appliances shall comply with visual signal appliance mounting requirements.

C. All wire and cable shall be new and UL listed and/or approved for use in fire alarm signal systems per the CEC, Articles 760, 770, and 800. All wire shall be conductors of copper, minimum size of No. 18 AWG.

1. Manufacturer's recommended wire type and gauge shall be used. If the fire alarm manufacturer specifies wire from a specific manufacturer(s), this wire shall be used unless the fire alarm manufacturer indicates in writing that other wire manufacturers are considered equal.

2. All wiring shall be appropriately color-coded, and permanent wire markers shall be used to identify the terminations for each circuit at the control panel.

3. All wiring shall be in enclosed raceways.

4. Splices shall be kept at a minimum. Splices shall be made in outlet boxes, junction boxes, and pull boxes.

D. All conduit, junction boxes, pull boxes, field terminal cabinets and fittings shall conform to the following:

1. All conduits shall be stamped with the name or trademark of the manufacturer and shall bear the UL label.

2. Conduit shall be 3/4-inch minimum and red in color.

3. Exposed conduit in areas visible to patients shall be painted to match the color of the surface to which the conduit is attached.

4. Electrical metallic conduit (EMT) shall be installed in accordance with the CEC.

5. Rigid steel conduit shall be used in areas where conduits may be exposed to physical damage. All rigid conduits shall be installed in accordance with the CEC.

6. All fittings and conduit bodies shall be listed and approved for the specific conduit.

7. Flexible metal conduit shall only be used to connect T-bar ceiling mounted appliances and devices. No run of flexible conduit shall exceed 6 feet in length.

8. For threaded rigid steel conduit, threadless or compression-type fittings are not permitted.

9. All EMT conduit fittings shall be steel compression type couplings and connectors.

10. Conduits installed above suspended ceilings shall be installed in such a manner that they do not interfere with accessing the ceiling space. All conduits shall be installed to run parallel with the suspended ceiling grid. The use of suspended ceiling grid support wires for conduit support is not permitted.

11. Install expansion fittings for conduits passing across all expansion and seismic joints. Pull boxes shall be installed on each side of all seismic and expansion joints.

12. All fire alarm conduit systems shall be routed and installed to minimize the potential for physical, mechanical, and by fire damage, and so as not to interfere with existing building systems, facilities or equipment, and to facilitate service and minimize maintenance.

13. All system conduits, junction boxes, pull boxes, terminal cabinets, electrical enclosures and device back boxes shall be readily accessible for inspection, testing, service, and maintenance.

14. All penetration of floor slabs and firewalls shall be sleeved (1-inch conduit minimum) and fire stopped in accordance with applicable standards and code minimum requirements using U.L. fire stopping material capable of maintaining the fire resistance rating of the fire barriers.

15. Actual wiring, conduit routing and sizing shall be determined by the contractor based upon current conditions at the time of installation.

E. Junction and Pull Boxes.

1. Shall be installed in accordance with the CEC, state, and local codes.

2. Provide galvanized sheet steel junction and pull boxes, with screw-on covers and of types, shapes, and sizes to suit each respective location and installation.

3. Boxes exposed to weather, moisture, at or adjacent to water or steam connections, at sprinkler waterflow switches and supervisory switches shall be corrosion-resistant, cast-metal weatherproof outlet boxes of types, shapes, and sizes, including depth of boxes with threaded conduit ends, cast-metal face plates with spring-hinged waterproof caps suitable for each application, including face plate gaskets and corrosion-resistant fasteners.

4. Each box shall be large enough to accommodate required splices and conduit in accordance with the CEC.

5. All boxes shall be painted red or otherwise designated for identification as part of the fire alarm system.

6. All boxes shall be supported as required by the CEC.

F. Field Terminal Cabinets (FTC).

1. Shall be installed in accordance with the CEC, state, and local codes.

2. Shall be UL listed for use in electrical wiring systems.

3. Minimum size shall be 12 inches by 12 inches by 4 inches deep with a hinged lockable cover or a plate cover.

4. Terminal strips shall be numbered and a list of all terminations shall be permanently affixed to the inside cover of all terminal cabinets.

5. Terminal cabinets shall be identified as part of the fire alarm system on the outward face of the cabinet.

6. All terminal cabinets shall be located in accessible areas.

G. Contractor shall furnish all material and labor to provide a complete and functional system, which operates in accordance with the requirements of this specification. This shall include the following:

1. Conduit, raceway and wiring systems as indicated herein, and throughout the specifications, and shown on the drawings.

a. All wiring shall be appropriately color-coded, and permanent wire markers shall be used to identify the terminations for each circuit at the control panel.

b. Strap or bundle all cables and wires inside equipment enclosures and terminal cabinets, parallel to the enclosure sides.

c. Splices shall be kept at a minimum. Splices shall be made in outlet boxes, junction boxes, and pull boxes. All fire alarm electrical box covers shall be red with white letters “FA".

d. All penetrations in walls shall be filled with UL fire-stopping material capable of maintaining the fire-resistance of the fire barriers.

3.2 TEST/FIELD QUALITY CONTROL

A. The final alarm acceptance test shall be coordinated with the Owner's representative. A letter certifying that the installation is complete and fully operational shall be forwarded to the Owner's representative.

B. The Contractor, the Owner's Representative, and the AHJ shall be in attendance at the final acceptance.

C. All fire alarm testing shall be in accordance with NFPA 72.

D. The system shall be pre-tested and documented prior to the final inspection by the AHJ. The Owner's representative shall be provided with a written request of the pretest 72 hours in advance and shall witness this test if desired.

3.3 TRAINING

A. Provide training of Owner's personnel in the proper operation procedures. The training program for the Owner's personnel shall include the following:

1. Operations and Maintenance Manuals in binder, containing complete operating instructions, outlining step-by-step procedures required for system start up, operation, and shut down, including the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operation features. Complete maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, trouble-shooting guide, and as-built drawings sheets of the complete system, including conduit layout, equipment layout, device labels, and simplified wiring and control diagrams of system. Three Operations and Maintenance Manuals shall be submitted and approved prior to conducting the training course.

2. Two separate 4-hour videotaped training sessions for operating personnel. The sessions are to cover proper operating and response procedures. These instructions shall be sufficient to enable an untrained person to properly operate the system.

3. Provide software manuals containing listings of all points, event programs, basic programming and instructions, and software troubleshooting information.

3.4 AS-BUILT DRAWINGS

A. Before acceptance of work and final completion, the record set of prints shall be used to prepare "As-Built" drawings in most recent version of AutoCAD, reflecting any and all changes and deviations made to the fire alarm system. The drawings shall indicate, at the minimum, the following:

1. As-built physical routing of wires to devices, including junction box locations.

2. As-built riser diagram showing the zoning of signaling line circuits and notification circuits.

3. As-built panel wiring diagrams of the fire alarm control panels.

4. Floor plan showing each alarm-initiating device, notification appliance, control and monitoring point with their respective address identification number.

B. Upon completion of the work, two sets of blackline record drawings shall be submitted to the Engineer for review.

C. Upon the Owner's review and acceptance of the record drawings, and before final approval, one copy on CD, and two (2) additional sets of blackline record drawings shall be delivered to the Owner.

D. Provide a complete set of "as-built" data sheets for all equipment connected to the system.

E. Provide an address list showing, for each device, the address, device type, location, and field custom message.

F. Provide a copy (on CD) of the data base used to program the system.

G. Provide a completed test form that complies with NFPA 72, signed and dated by the fire alarm system manufacturer or his agent.

H. Provide NFPA 72 completion certificate, signed by the AHJ.

I. All items of this section and in Owner's criteria shall be provided prior to final payment request.

3.5 SPARE PARTS

A. Spare parts shall be interchangeable with the corresponding components of the installed systems.

B. The following spare parts shall be furnished to the Owner. Provide the percentage of each device in the project as listed below; minimum of 1.

1. Smoke detector heads.
2. Heat detector heads.
3. Smoke/Heat detector 2-wire bases.
4. Smoke/Heat detector relay bases.
5. Duct type smoke detector.
6. Control relays/devices.
7. Addressable monitoring modules.
8. Strobe appliances.
9. Audible/strobe appliances.
10. Manual pull stations.
11. Keys for the manual pull stations and fire alarm control panels.

END OF SECTION

SECTION 311000 – SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

SUMMARY

A. Section includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Stripping and stockpiling rock.
6. Removing above-and below-grade site improvements.
7. Disconnecting, capping or sealing, removing site utilities and abandoning site utilities in place.
8. Temporary erosion and sedimentation control.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for temporary erosion-and sedimentation-control measures.

C. Related Requirements:

1. Section 01500 "Temporary Facilities and Controls" for temporary erosion-and sedimentation-control measures.

1.3 DEFINITIONS

A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow.

D. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects larger than 2 inches in diameter; and free of weeds, roots, toxic materials, or other nonsoil materials.

E. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.

F. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated according to requirements in Section 015639 "Temporary Tree and Plant Protection."

G. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 MATERIAL OWNERSHIP

A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.6 INFORMATIONAL SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.

1. Use sufficiently detailed photographs or video recordings.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plant designated to remain.

B. Topsoil stripping and stockpiling program.

C. Rock stockpiling program.

D. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

E. Burning: Documentation of compliance with burning requirements and permitting of authorities having jurisdiction. Identify location(s) and conditions under which burning will be performed.

1.7 QUALITY ASSURANCE

A. Topsoil Stripping and Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.

B. Rock Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.

1.8 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.

2. Provide alternate routes around closed or obstructed trafficways if required by Owner or authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.

1. Do not proceed with work on adjoining property until directed by Architect.

C. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

D. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

E. Do not commence site clearing operations until temporary erosion-and sedimentation-control and plant-protection measures are in place.

F. Tree-and Plant-Protection Zones: Protect according to requirements in Section 015639 "Temporary Tree and Plant Protection."

G. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

PART 2 -PRODUCTS

MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."

1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 -EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed according to requirements in Section 015639 "Temporary Tree and Plant Protection."

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion-and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion-and sedimentation-control Drawings and requirements of authorities having jurisdiction.

1 B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

C. Inspect, maintain, and repair erosion-and sedimentation-control measures during construction until permanent vegetation has been established.

D. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

A. Protect trees and plants remaining on-site according to requirements in Section 015639 "Temporary Tree and Plant Protection."

B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.4 EXISTING UTILITIES

A. Owner will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing, when requested by Contractor.

1. Verify that utilities have been disconnected and capped before proceeding with site clearing.

B. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.

1 Arrange with utility companies to shut off indicated utilities.
2 Owner will arrange to shut off indicated utilities when requested by Contractor.

C. Locate, identify, and disconnect utilities indicated to be abandoned in place.

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

1 Notify Architect not less than two days in advance of proposed utility interruptions.
2 Do not proceed with utility interruptions without Architect's written permission.

E. Excavate for and remove underground utilities indicated to be removed.

F. Removal of underground utilities is included in earthwork sections; in applicable fire suppression, plumbing, HVAC, electrical, communications, electronic safety and security, and utilities sections; and in Section 024116 "Structure Demolition" and Section 024119 "Selective Demolition."

3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.

1 Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
2 Grind down stumps and remove roots larger than 2 inches in diameter, obstructions, and debris to a depth of 18 inches below exposed subgrade.
3 Use only hand methods or air spade for grubbing within protection zones.
4 Chip removed tree branches and dispose of off-site.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

2 1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to depth of 6 inches in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects larger than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

1 Limit height of topsoil stockpiles to 72 inches.
2 Do not stockpile topsoil within protection zones.
3 Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.
4 Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.7 STOCKPILING ROCK

A. Remove from construction area naturally formed rocks that measure more than 1 foot across in least dimension. Do not include excavated or crushed rock.

1. Separate or wash off non-rock materials from rocks, including soil, clay lumps, gravel, and other objects larger than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.

B. Stockpile rock away from edge of excavations without intermixing with other materials. Cover to prevent windblown debris from accumulating among rocks.

1 Limit height of rock stockpiles to 36 inches.
2 Do not stockpile rock within protection zones.
3 Dispose of surplus rock. Surplus rock is that which exceeds quantity indicated to be stockpiled or reused.
4 Stockpile surplus rock to allow later use by the Owner.

3.8 SITE IMPROVEMENTS

A. Remove existing above-and below-grade improvements as indicated and necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

— Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.

— Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.9 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

B. Burning tree, shrub, and other vegetation waste is permitted according to burning requirements and permitting of authorities having jurisdiction. Control such burning to produce the least smoke or air pollutants and minimum annoyance to surrounding properties. Burning of other waste and debris is prohibited.

C. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials, and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 311000

SECTION 312000 - EARTHMOVING

PART 1 -GENERAL

RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Excavating and filling for rough grading the Site.
2. Preparing subgrades for slabs-on-grade, walks, pavements, turf and grasses, and plants.
3. Excavating and backfilling for buildings and structures.
4. Drainage course for concrete slabs-on-grade.
5. Subbase course for concrete pavements.
6. Subbase course and base course for asphalt paving.
7. Subsurface drainage backfill for walls and trenches.
8. Excavating and backfilling trenches for utilities and pits for buried utility structures.
9. Excavating well hole to accommodate elevator-cylinder assembly.

B. Related Requirements:

1. Section 013200 "Construction Progress Documentation" for recording preexcavation and earth-moving progress.
1. Section 033000 "Cast-in-Place Concrete" for granular course if placed over vapor retarder and beneath the slab-on-grade.
2. Section 311000 "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above-and below-grade improvements and utilities.
3. Section 312319 "Dewatering" for lowering and disposing of ground water during construction.
4. Section 329200 "Turf and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.
5. Section 329300 "Plants" for finish grading in planting areas and tree and shrub pit excavation and planting.

1.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.

3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. for bulk excavation or 3/4 cu. yd. for footing, trench, and pit excavation that cannot be removed by rock-excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:

1. Equipment for Footing, Trench, and Pit Excavation: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch-maximum-width, short-tip-radius rock bucket; rated at not less than 138-hp flywheel power with bucket-curling force of not less than 28,700 lbf and stick-crowd force of not less than 18,400 lbf with extra-long reach boom.

2. Equipment for Bulk Excavation: Late-model, track-mounted loader; rated at not less than 230-hp flywheel power and developing a minimum of 47,992-lbf breakout force with a general-purpose bare bucket.

I. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cu. yd. or more in volume that exceed a standard penetration resistance of 100 blows/2 inches when tested by a geotechnical testing agency, according to ASTM D 1586.

J. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

K. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

L. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

M. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct preexcavation conference at Project site>.

1. Review methods and procedures related to earthmoving, including, but not limited to, the following:

    a. Personnel and equipment needed to make progress and avoid delays.

    b. Coordination of Work with utility locator service.

    c. Coordination of Work and equipment movement with the locations of tree-and plant-protection zones.

    d. Extent of trenching by hand or with air spade.

    e. Field quality control.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of the following manufactured products required:

    1. Geotextiles.

    2. Controlled low-strength material, including design mixture.

    3. Warning tapes.

B. Samples for Verification: For the following products, in sizes indicated below:

    1. Geotextile: 12 by 12 inches.

    2. Warning Tape: 12 inches long; of each color.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Material Test Reports: For each borrow soil material proposed for fill and backfill as follows:

    1. Classification according to ASTM D 2487.

    2. Laboratory compaction curve according to ASTM D 1557.

C. Seismic survey report from seismic survey agency.

D. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth-moving operations. Submit before earth moving begins.

1.7 QUALITY ASSURANCE

A. Blasting: Blasting will not be allowed.

1.8 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.

2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth-moving operations.

C. Do not commence earth-moving operations until temporary site fencing and erosion-and sedimentation-control measures specified in Section 015000 "Temporary Facilities and Controls" and Section 311000 "Site Clearing" are in place.

D. Do not commence earth-moving operations until plant-protection measures specified in Section 015639 "Temporary Tree and Plant Protection" are in place.

E. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.

2. Parking vehicles or equipment.

3. Foot traffic.

4. Erection of sheds or structures.

5. Impoundment of water.

6. Excavation or other digging unless otherwise indicated.

7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

F. Do not direct vehicle or equipment exhaust towards protection zones.

G. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 294/D 2940M 0; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.

F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

H. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and zero to 5 percent passing a No. 8 sieve.

I. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and zero to 5 percent passing a No. 4 sieve.

J. Sand: ASTM C 33/C 33M; fine aggregate.

K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 GEOTEXTILES

A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.

2. Survivability: As follows:

a. Grab Tensile Strength: 157 lbf; ASTM D 4632.

b. Sewn Seam Strength: 142 lbf; ASTM D 4632.

c. Tear Strength: 56 lbf; ASTM D 4533.

d. Puncture Strength: 56 lbf; ASTM D 4833.

3. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.

4. Permittivity: 0.2 per second, minimum; ASTM D 4491.

5. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.

2. Survivability: As follows:

    a. Grab Tensile Strength: 247 lbf; ASTM D 4632.

    b. Sewn Seam Strength: 222 lbf; ASTM D 4632.

    c. Tear Strength: 90 lbf; ASTM D 4533.

    d. Puncture Strength: 90 lbf; ASTM D 4833.

3. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.

4. Permittivity: 0.02 per second, minimum; ASTM D 4491.

5. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

2.3 CONTROLLED LOW-STRENGTH MATERIAL

A. Controlled Low-Strength Material: Self-compacting, low-density, flowable concrete material produced from the following:

1. Portland Cement: ASTM C 150/C 150M, Type II.

2. Fly Ash: ASTM C 618, Class C or F.

3. Normal-Weight Aggregate: ASTM C 33/C 33M, 3/4-inch nominal maximum aggregate size.

4. Foaming Agent: ASTM C 869/C 869M.

5. Water: ASTM C 94/C 94M.

6. Air-Entraining Admixture: ASTM C 260/C 260M.

B. Produce low-density, controlled low-strength material with the following physical properties:

C. As-Cast Unit Weight: 30 to 36 lb/cu. ft. at point of placement, when tested according to ASTM C 138/C 138M.

D. Compressive Strength: 80 psi, when tested according to ASTM C 495/C 495M.

E. Produce conventional-weight, controlled low-strength material with 80-psi compressive strength when tested according to ASTM C 495/C 495M.

2.4 ACCESSORIES

A. Detectable Warning Tape: Acid-and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously

inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.

B. Protect and maintain erosion and sedimentation controls during earth-moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.3 EXPLOSIVES

A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

A. Rock excavation includes removal and disposal of rock. Remove rock to lines and subgrade elevations indicated to permit installation of permanent construction without exceeding the following dimensions:

1. 24 inches outside of concrete forms other than at footings.
2. 12 inches outside of concrete forms at footings.
3. 6 inches outside of minimum required dimensions of concrete cast against grade.
4. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
5. 6 inches beneath bottom of concrete slabs-on-grade.
6. 6 inches beneath pipe in trenches and the greater of 24 inches wider than pipe or 42 inches wide.

3.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

2. Pile Foundations: Stop excavations 6 to 12 inches above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.

3. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.

B. Excavations at Edges of Tree-and Plant-Protection Zones:

1. Excavate by hand or with an air spade to indicated lines, cross sections, elevations, and subgrades. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

2. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: 12 inches each side of pipe or conduit.

A. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. For pipes and conduit less than 6 inches in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.

2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.

3. For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on an undisturbed subgrade.

4. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

D. Trenches in Tree-and Plant-Protection Zones:

1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.

3. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.9 SUBGRADE INSPECTION

A. Notify Architect when excavations have reached required subgrade.

B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.

2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

A. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

B. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.10 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Architect.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.11 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.12 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.

2. Surveying locations of underground utilities for Record Documents.

3. Testing and inspecting underground utilities.

4. Removing concrete formwork.

5. Removing trash and debris.

6. Removing temporary shoring, bracing, and sheeting.

7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.13 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Section 033000 "Cast-in-Place Concrete."

D. Backfill voids with satisfactory soil while removing shoring and bracing.

E. Initial Backfill:

1. Soil Backfill: Place and compact initial backfill of subbase material, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.

a. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

2. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches over the pipe or conduit. Coordinate backfilling with utilities testing.

F. Final Backfill:

1. Soil Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.

2. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation.

G. Warning Tape: Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.14 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.

2. Under walks and pavements, use satisfactory soil material.

3. Under steps and ramps, use engineered fill.

4. Under building slabs, use engineered fill.

5. Under footings and foundations, use engineered fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.15 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

A. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.

B. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.16 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.

2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 90 percent.

3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 90 percent.

4. For utility trenches, compact each layer of initial and final backfill soil material at 90 percent.

3.17 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.

2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:

1. Turf or Unpaved Areas: Plus or minus 1 inch.

2. Walks: Plus or minus 1/2 inch.

3. Pavements: Plus or minus 1/2 inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.18 SUBSURFACE DRAINAGE

A. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches of filter material, placed in compacted layers 6 inches thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches.

1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698.

B. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade, in compacted layers 6 inches thick. Overlay drainage backfill with one layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches.

1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698.

2. Place and compact impervious fill over drainage backfill in 6-inch-thick compacted layers to final subgrade.

3.19 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:

1. Install separation geotextile on prepared subgrade (where required) according to manufacturer's written instructions, overlapping sides and ends.

2. Place base course material over subbase course under hot-mix asphalt pavement.

3. Shape subbase course and base course to required crown elevations and cross-slope grades.

4. Place subbase course and base course 6 inches or less in compacted thickness in a single layer.

5. Place subbase course and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.

6. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

3.20 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:

1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.

2. Place drainage course 6 inches or less in compacted thickness in a single layer.

3. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.

4. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.21 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Determine prior to placement of fill that site has been prepared in compliance with requirements.

2. Determine that fill material classification and maximum lift thickness comply with requirements.

3. Determine, during placement and compaction, that in-place density of compacted fill complies with requirements.

A. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.

D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2937, and ASTM D 6938, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. or less of paved area or building slab but in no case fewer than three tests.

2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet or less of wall length but no fewer than two tests.

3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet or less of trench length but no fewer than two tests.

E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.22 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.23 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

B. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.

1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 312000

SECTION 321216 – ASPHALT PAVING

PART 1 -GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cold milling of existing asphalt pavement.
2. Hot-mix asphalt patching.
3. Hot-mix asphalt paving.
4. Hot-mix asphalt overlay.
5. Asphalt surface treatments.

B. Related Requirements:

1. Section 024119 "Selective Demolition" for demolition and removal of existing asphalt pavement.
2. Section 312000 "Earth Moving" for subgrade preparation, fill material, unbound-aggregate subbase and base courses, and aggregate pavement shoulders.
3. Section 321373 "Concrete Paving Joint Sealants" for joint sealants and fillers at pavement terminations.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:

a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
b. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include technical data and tested physical and performance properties.
2. Job-Mix Designs: For each job mix proposed for the Work.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each paving material include statement that mixes containing recycled materials will perform equal to mixes produced from all new materials.
B. Material Test Reports: For each paving material, by a qualified testing agency.
C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by authorities having jurisdiction or CalTrans.

B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.

C. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of Standard Specifications of CalTrans for asphalt paving work.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:

1. Tack Coat: Minimum surface temperature of 60 deg F.
2. Slurry Coat: Comply with weather limitations in ASTM D 3910.
3. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
4. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations.

B. Coarse Aggregate: ASTM D 692/D 692M, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.

C. Fine Aggregate: ASTM D 1073 or AASHTO M 29, sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.

a. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.

D. Mineral Filler: ASTM D 242/D 242M or AASHTO M 17, rock or slag dust, hydraulic cement, or other inert material.

2.2 ASPHALT MATERIALS

A. Asphalt Binder: AASHTO M 320, PG 64-10.

B. Asphalt Cement: ASTM D 946/D 946M for penetration-graded material.

C. Tack Coat: ASTM D 977 or AASHTO M 140 emulsified asphalt, or ASTM D 2397 or AASHTO M 208 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

D. Fog Seal: ASTM D 977 or AASHTO M 140 emulsified asphalt, or ASTM D 2397 or AASHTO M 208 cationic

E. emulsified asphalt, slow setting, factory diluted in water, of suitable grade and consistency foapplication.

F. Water: Potable.

G. Undersealing Asphalt: ASTM D 3141/D 3141M; pumping consistency.

2.3 AUXILIARY MATERIALS

A. Recycled Materials for Hot-Mix Asphalt Mixes: Reclaimed asphalt pavement; reclaimed, unbound-aggregate base material; and recycled tires from sources and gradations that have performed satisfactorily in previous installations, equal to performance of required hot-mix asphalt paving produced from all new materials.

B. Herbicide: Commercial chemical for weed control, registered by the EPA, and not classified as "restricted use" for locations and conditions of application. Provide in granular, liquid, or wettable powder form.

C. Sand: ASTM D 1073 or AASHTO M 29, Grade No. 2 or No. 3.

D. Paving Geotextile: AASHTO M 288 paving fabric; nonwoven polypropylene; resistant to chemical attack, rot, and mildew; and specifically designed for paving applications.

2.4 MIXES

A. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction; designed according to procedures in AI MS-2, "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types"; and complying with the following requirements:

1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
2. Base Course: 3/4 inch open graded.
3. Surface Course: 1/2 inch medium.

B. **Emulsified-Asphalt Slurry: ASTM D 3910**

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

C. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 COLD MILLING

A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.

1. Mill to a depth of 1.5 inches.

2. Mill to a uniform finished surface free of excessive gouges, grooves, and ridges.
3. Control rate of milling to prevent tearing of existing asphalt course.
4. Repair or replace curbs, manholes, and other construction damaged during cold milling.
5. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
6. Patch surface depressions deeper than 1 inch after milling, before wearing course is laid.
7. Handle milled asphalt material according to approved waste management plan required in Section 017419 "Construction Waste Management and Disposal."
8. Keep milled pavement surface free of loose material and dust.
9. Do not allow milled materials to accumulate on-site.

3.3 PATCHING

A. Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseat concrete pieces firmly.

1. Pump hot undersealing asphalt under rocking slab until slab is stabilized or, if necessary, crack slab into pieces and roll to reseat pieces firmly.
2. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.

C. Tack Coat: Before placing patch material, apply tack coat uniformly to vertical asphalt surfaces abutting the patch. Apply at a rate of 0.05 to 0.15 gal./sq. yd..

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

D. Placing Patch Material: Fill excavated pavement areas with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

E. Placing Patch Material: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

3.4 REPAIRS

A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch in existing pavements.

1. Install leveling wedges in compacted lifts not exceeding 3 inches thick.

B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch.

1. Clean cracks and joints in existing hot-mix asphalt pavement.
2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.
3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

3.5 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.

1. Mix herbicide with prime coat if formulated by manufacturer for that purpose.

C. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd..

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.6 PAVING GEOTEXTILE INSTALLATION

A. Apply tack coat uniformly to existing pavement surfaces at a rate of 0.20 to 0.30 gal./sq. yd..

B. Place paving geotextile promptly according to manufacturer's written instructions. Broom or roll geotextile smooth and free of wrinkles and folds. Overlap longitudinal joints 4 inches and transverse joints 6 inches.

C. Protect paving geotextile from traffic and other damage, and place hot-mix asphalt overlay the same day.

3.7 PLACING HOT-MIX ASPHALT

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
2. Place hot-mix asphalt surface course in single lift.
3. Spread mix at a minimum temperature of 250 deg F.
4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Overlap mix placement about 1 to 1-1/2 inches from strip to strip to ensure proper compaction of mix along longitudinal joints.
2. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.8 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
3. Offset transverse joints, in successive courses, a minimum of 24 inches.
4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.9 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent or greater than 96 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.10 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch.
2. Surface Course: Plus 1/4 inch, no minus.

A. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:

1. Base Course: 1/4 inch.
2. Surface Course: 1/8 inch.
3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

3.11 SURFACE TREATMENTS

A. Fog Seals: Apply fog seal at a rate of 0.10 to 0.15 gal./sq. yd. to existing asphalt pavement and allow to cure. With fine sand, lightly dust areas receiving excess fog seal.

B. Slurry Seals: Apply slurry coat in a uniform thickness according to ASTM D 3910 and allow to cure.

1. Roll slurry seal to remove ridges and provide a uniform, smooth surface.

3.12 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.

C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979 or AASHTO T 168.

1. .Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.
    a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than three cores taken.
    b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.

E. Replace and compact hot-mix asphalt where core tests were taken.

F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.13 WASTE HANDLING

A. General: Handle asphalt-paving waste according to approved waste management plan required in Section 017419 "Construction Waste Management and Disposal."

END OF SECTION 321216

SECTION 32 12 43 - POROUS FLEXIBLE PAVING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Porous pavement system.

1.2 Related Requirements

1. Section 329300 “Plants”
2. Section 329200 “Turf and Grasses”
3. Section 328400 “Planting Irrigation”

1.3 REFERENCES

A. ASTM D 638-10 Standard Test Method for Tensile Properties of Plastics
B. ASTM C 33 Standard Specification for Concrete Aggregates
C. AASHTO M6 Standard Specification for Fine Aggregate for Hydraulic Cement Concrete

1.4 SYSTEM DESCRIPTION

A. The Grasspave2 porous pavement system provides vehicular and pedestrian load support for grass areas, while protecting grass roots from harmful effects of traffic.
B. Major Components of the Complete System

1. Grasspave2 units, assembled in rolls.
2. Engineered sand and gravel base course.
3. Hydrogrow soil amendment and fertilizer, supplied with Grasspave2.
4. Sand fill or USGA greens mix.
5. Selected grasses from plugs.
6. Selected topsoil.

C. The Grasspave2 grass paving units, sand, and base course work together to support imposed loading.
D. The Grasspave2 grass paving units, Hydrogrow, and sand fill and topsoil contribute to vegetation support.

1.5 SUBMITTALS

A. Submit under provisions of Section 01 30 00.
B. Shop Drawings: Submit design detail showing proper cross-section.
C. Samples: Submit manufacturer's sample of Grasspave2 10” x 10” section of Grasspave2 material.
D. Installation Instructions: Manufacturer’s printed installation instructions. Include methods for maintaining installed products.
E. Certificates:

1. Manufacturer signed certificate stating the product is made in the USA.
2. Submit Material Certificates for base course and sand (or USGA mix) fill materials
3. Product certificates signed by the manufacturer certifying material compliance of polyethylene used to make Grasspave2 units.

4. ISO Certificate certifying manufacturer's quality management system is currently registered to ISO 9001:2008 quality standards.

F. Substitutions: No material will be considered as an equivalent to the Grasspave2 unit specified herein unless it meets all areas of this specification without exception. Manufacturers seeking to supply what they represent as equivalent material must submit records, data, independent test results, samples, certifications, and documentation deemed necessary by the Specifier to prove equivalency.

G. Manufacturer's Material Certification: Product manufacturers shall provide certification of compliance with all applicable testing procedures and related specifications upon written request. Request for certification shall be submitted by the purchasing agency no later than the date of order placement.

H. Product manufacturers shall also have a minimum of 30 years' experience producing products for porous pavement systems.

I. Manufacturer Quality Certification: ISO Certification certifying manufacturer's quality management system for its Grasspave2 system is currently registered to ISO 9001:2008 quality standards. Any alternate materials submitted shall provide a certification that their porous pavement system manufacturing process is part of an ISO program and a certification will be required specifically stating that their testing facility is certified and in accordance with ISO.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.
B. Protect Grasspave2 units/rolls from damage during delivery and store rolls upright, under tarp, to protect from sunlight, when time for delivery to installation exceeds one week.
C. Store Hydrogrow in a dark and dry location.
D. Handling: Protect materials during handling and installation to prevent damage.

1.7 MAINTENANCE SERVICE

A. Installer responsible for maintenance of grass plants – water/irrigation, fertilizing, mowing – for one growing season. DO NOT AERATE. See Grasspave2 Maintenance Guide from Invisible Structures
B. System to be maintained by owner, after one growing season.

1.8 PROJECT CONDITIONS

A. Maintain environmental conditions within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
B. Do not begin installation of porous pavements until all hard surface paving adjacent to porous pavement areas, including concrete walks and asphalt paving, is completed.
C. Install turf when ambient air temperatures is at least 55 degrees F (13 degrees C).
D. In cold weather, do not use frozen materials or materials mixed or coated with ice or frost, and do not build on frozen base or wet, saturated or muddy subgrade.
E. Protect partially completed paving against damage from other construction traffic when work is in progress.
F. Adequately water plugs to ensure growth of root system.
G. Grass coverage on the sand-filled Grasspave2 rings must be completed within one week: See Part 3 Execution.
H. DO NOT DRIVE, PARK ON, or use Grasspave2 system until grass root system has matured (about 6 to 8 weeks for plugged areas). Any barricades constructed must still be accessible by emergency and fire equipment during and after installation.

1.9 LIMITED WARRANTY

A. Invisible Structures, Inc. (ISI) warrants to its purchasers that all products furnished by ISI will be free from defects in material and/or workmanship.

B. This warranty shall be extended for a period of five (5) years following the date of shipment by ISI.
C. Providing a written claim is presented to ISI within the warranty period and after inspection by ISI showing the materials have failed under this warranty, all defective materials shall be refurnished under this warranty, at no charge, excluding re-installation costs. This in lieu of all other warranties expressed or implied and is the sole warranty extended by ISI.
D. Our liability under this warranty is limited to the refurnishing of materials and does not include any responsibility for incidental, consequential, or other damages of any nature.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Invisible Structures, Inc., which is located at: 1600 Jackson St. Suite 310 ; Golden, CO 80401; Toll Free Tel: 800-233-1510; Tel: 303-233-8383; Email: request info (sales@invisiblestructures.com); Web: www.invisiblestructures.com.

2.2 GRASSPAVE2

A. Composition:

1. Manufactured in the USA.
2. High density polyethylene (HDPE): 100 percent recycled materials.
3. Color: black
4. Color Uniformity: Uniform color throughout all units rolls.
5. Carbon Black for ultraviolet light stabilization.
6. Hydrogrow soil amendment and fertilizer, provided by manufacturer with Grasspave2.

B. Performance Properties:

1. Maximum Loading Capability: 15,940 psi when filled with sand.
2. Wheelchair Access testing for ADA Compliance: Passing ASTM F 1951-08.
3. Wheelchair Access testing for ADA Compliance: Passing Rotational Penetrometer testing.
4. Tensile strength, pull-apart testing: 458 lbf/in from ASTM D638 Modified.
5. System Permeability (Grasspave2, sand, base course): 2.63 to 38.55 inches of water per hour.
6. Effective Imperviousness (E.I.): 10%.

C. Dimensions (individual units are assembled and distributed into rolls):

1. Roll area: From 108 sq ft to 538 sq ft, in 108 sq ft increments
2. Roll Widths: From 3.3 ft to 8.2 ft, in 1.6 ft increments.
3. Roll Lengths: From 32.8 ft to 65.6 ft, in 3.3 ft increments.
4. Roll Weights: From 41 lbs to 205 lbs , in 41 lbs increments.
5. Unit Nominal Width by Length: 20 inches by 20 inches or 40 inches by 40 inches.
6. Nominal Depth: 1 inch – for rolls and individual units.
7. Unit Weight: 18 oz or 5 lbs.
8. Volume Solid: 8 percent.

2.3 SYSTEM MATERIALS

A. Base Course: Sandy gravel material from local sources commonly used for road base construction (recycled materials such as crushed concrete or crushed asphalt are NOT acceptable).

1. Conforming to the following sieve analysis and requirements:
   a. 100 percent passing sieve size 1 inch.
   b. 90-100 percent passing sieve size 3/4 inch.
   c. 70-80 percent passing sieve size 3/8 inch.
   d. 55-70 percent passing sieve size #4.

e. 45-55 percent passing sieve size #10.
f. 25-35 percent passing sieve size #40.
g. 3-8 percent passing sieve size #200.

2. Provide a base course material nearly neutral in pH (range from 6.5 to 7.2) to provide adequate root zone development for turf.
3. Material may be either "pit run" or "crusher run." Avoid using clay based crusher run/pit run. Crusher run material will generally require coarse, well-draining sand conforming to AASHTO M6 or ASTM C 33 to be added to mixture (20 to 30 percent by volume) to ensure long-term porosity.

B. Sand Fill for Rings and Spaces Between Rings: Clean sharp sand (washed concrete sand). Choose one of the following:

1. Coarse, well-draining sand, such as washed concrete sand conforming to AASHTO M6 or ASTM C-33.
2. United States Golf Association (USGA) greens, section - sand mix “The Root Zone Mixture.”

C. Turf Conditioner:
1. Hydrogrow a proprietary soil amendment manufactured by Invisible Structures, Inc. and provided with Grasspave2.
2. NO SUBSTITUTIONS.

D. Grass plugs:

1. Plugs: Plugs shall be grown in sand or sandy loam soils only. Plugs grown in soils of clay, silt, or high organic materials such as peat, will not be accepted.
a. Install ½”- Class A Sandy Loam Topsoil with a minimum of 85% sand content, above rings filled with sand prior to installing plugs.

PART 3 - EXECUTION

3.1 Inspection

A. Examine subgrade and base course installed conditions. Do not start porous paving installation until unsatisfactory conditions are corrected. Check for improperly compacted trenches, debris, and improper gradients.
B. For fire lane installations: prior to installing base course for turf paving, obtain approval of local fire authorities of sub-base.
C. Start of installation constitutes acceptance of existing conditions and responsibility for satisfactory performance. If existing conditions are found unsatisfactory, contact Architect for resolution.

3.2 PREPARATION

A. Subgrade Preparation:

1. Prepare subgrade as specified in Section 32 10 00. Verify subgrade in accordance with porous paving system manufacturer's instructions.
2. Proper subgrade preparation will enable the Grasspave2 rolls/units to connect properly and remain level and stationary after installation.
3. Excavate area allowing for unit thickness, the engineered base depth (where required), and 1/2 inch for depth of topsoil for plugs.
4. Provide adequate drainage from excavated area if area has potential to collect water, when working with in-place soils that have poor permeability.
5. Ensure in-place soil is relatively dry and free from standing water.
6. Uniformly grade base.
7. Level and clear base of large objects, such as rocks and pieces of wood.

B. Base Preparation:
   1. Install Base as specified in Section 32 10 00. Verify engineered base (if required) is installed in accordance with porous paving system manufacturer's instructions.
   2. Coordinate base installation and preparation with sub-drains specified in Section 33 46 00.
   3. If required, place a geotextile separation layer between the natural ground and the 'engineered base'.
   4. If required, install the specified sub-drain and outlet according to construction drawings.
   5. Coordinate base installation and preparation with irrigation and drip irrigation lines specified in Section 32 80 00 and 32 84 13, respectively.
   6. Place engineered base in lifts not to exceed 6 inches, compacting each lift separately to 95 percent Modified Proctor.
   7. Leave 1 inch of depth below final grade for porous paver unit and sand fill and 1/2 inch for depth of topsoil and plugs.

3.3 ON-SITE MANUFACTURER'S FIELD REPRESENTATIVE

A. A qualified Manufacturer's field representative shall be available for a pre-construction meeting via phone or in person and will provide installation videos, design details, installation instructions, and the technical specifications.
B. The time for on-site observation shall be indicated in the Contract Documents and included in the base bid price.

3.4 HYDROGROW INSTALLATION

A. Spread all Hydrogrow mix provided spreader rate = 10 lbs per 1076 ft2 evenly over the surface of the base course with a hand-held, or wheeled, rotary spreader.
B. The Hydrogrow mix should be placed immediately before installing the Grasspave2.

3.5 GRASSPAVE2 INSTALLATION

A. Install the Grasspave2 units by placing units with rings facing up, and using snap-fit connectors, pegs and holes, provided to maintain proper spacing and interlock the units. Units can be easily shaped with pruning shears or knife. Units placed on curves, slopes, and high traffic areas shall be anchored to the base course, using 40d common nails with fender washer, as required to secure units in place. Tops of rings shall be 1/2" below the surface of adjacent hard-surface pavements.
B. Install sand in rings as they are laid in sections by "back-dumping" directly from a dump truck, or from buckets mounted on tractors, which then exit the site by driving over rings already filled with sand. The sand is then spread laterally from the pile using flat bottomed shovels and/or wide "asphalt rakes" to fill the rings. A stiff bristled broom should be used for final "finishing" of the sand. The sand must be "compacted" by using water from hose, irrigation heads, or rainfall, with the finish grade no less than the top of rings and no more than 6 mm (0.25") above top of rings.

3.6 Installation of Plugs

A. Grass coverage (plug installation) in the sand-filled rings must be completed within one week. Sand must be re-installed and leveled and Grasspave2 checked for integrity if rings become exposed due to wind, rain, traffic, or other factors.

   1. Install topsoil and plugs directly over sand filled rings, filled no higher than the top of the rings. Sod strips should be placed with very tight joints. Sodded areas must be fertilized and kept moist during root establishment (minimum of 3 weeks). DO NOT DRIVE ON SYSTEM: Plugged areas must be protected from any traffic, other than emergency vehicles, for a period of 6 to 8 weeks, or until the root system has penetrated and established well below the Grasspave2 units.

B. Adequately water plugs to ensure growth of root system.

3.7 Protection

A. Planted areas must be protected from any traffic, other than emergency vehicles, for a period of 6 to 8 weeks, or until the root system has penetrated below the Grasspave2 units.

3.8 FIELD QUALITY CONTROL

A. Remove and replace segments of Grasspave2 units where three or more adjacent rings are broken or damaged, reinstalling as specified, so no evidence of replacement is apparent.
B. Perform cleaning during the installation of work and upon completion of the work. Remove all excess materials, debris, and equipment from site. Repair any damage to adjacent materials and surfaces resulting from installation of this work.

3.9 MAINTENANCE

A. Maintain grass in accordance with manufacturer's instructions and as specified in Section 32 92 00 Manufacturers of Turfs and Grasses.
B. DO NOT AERATE. Aerator will damage the Grasspave2 units. Aeration is not necessary in a sand root zone.

END OF SECTION 321243
POROUS FLEXIBLE PAVING

SECTION **321313** – **CONCRETE PAVING**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes Concrete Paving Including the Following:

1. Driveways.
2. Roadways.
3. Parking lots.
4. Curbs and gutters.
5. Walks.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for general building applications of concrete.
2. Section 321373 "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.
3. Section 321723 "Pavement Markings."
4. Section 321726 "Tactile Warning Surfacing" for detectable warning tiles and mats.
5. Section 321316 Decorative Concrete Paving

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to concrete paving, including but not limited to, the following:

a. Concrete mixture design.

b. Quality control of concrete materials and concrete paving construction practices.

2. Require representatives of each entity directly concerned with concrete paving to attend, including the following:

   a. Contractor's superintendent.
   b. Independent testing agency responsible for concrete design mixtures.
   c. Ready-mix concrete manufacturer.
   d. Concrete Paving Subcontractor
   e. Manufacturer's representative of stamped concrete paving system used for stamped detectable warnings.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Initial Selection: For each type of product, ingredient, or admixture requiring color selection.

C. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified ready-mix concrete manufacturer.

B. Material Certificates: For the following, from manufacturer:

1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Fiber reinforcement.
4. Admixtures.
5. Curing compounds.
6. Applied finish materials.
7. Bonding agent or epoxy adhesive.
8. Joint fillers.

C. Material Test Reports: For each of the following:

1. Aggregates: Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

D. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Stamped Detectable Warning Installer Qualifications: An employer of workers trained and approved by manufacturer of stamped concrete paving systems.

B. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual -Section 3, "Plant Certification Checklist").

C. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups of full-thickness sections of concrete paving to demonstrate typical joints; surface finish, texture, and color; curing; and standard of workmanship.

2. Build mockups of concrete paving in the location and of the size indicated or, if not indicated, build mockups where directed by Architect and not less than 96 inches by 96 inches. Include full-size detectable warning.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified independent testing agency to perform preconstruction testing on concrete paving mixtures.

1.9 FIELD CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:

1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.

2. Do not use frozen materials or materials containing ice or snow.

3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

C. Hot-Weather Concrete Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Cover steel reinforcement with water-soaked burlap, so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.

3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

PART 2 -PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 unless otherwise indicated.

2.2 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less. Do not use notched and bent forms.

A. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.3 STEEL REINFORCEMENT

A. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, fabricated from steel wire into flat sheets.

B. Deformed-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, flat sheet.

C. Epoxy-Coated Welded-Wire Reinforcement: ASTM A 884/A 884M, Class A, plain steel.

D. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.

E. Galvanized Reinforcing Bars: ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A 615/A 615M, Grade 60 deformed bars.

F. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M or ASTM A 934/A 934M; with ASTM A 615/A 615M, Grade 60 deformed bars.

G. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60 deformed bars; assembled with clips.

H. Plain-Steel Wire: ASTM A 1064/A 1064M.

I. Deformed-Steel Wire: ASTM A 1064/A 1064M.

J. Epoxy-Coated-Steel Wire: ASTM A 884/A 884M, Class A; coated, plain.

K. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 plain-steel bars. Cut bars true to length with ends square and free of burrs.

L. Epoxy-Coated, Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60 plain-steel

bars.

M. Tie Bars: ASTM A 615/A 615M, Grade 60; deformed.

N. Hook Bolts: ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

O. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded-wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

P. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.

Q. Zinc Repair Material: ASTM A 780/A 780M.

2.4 CONCRETE MATERIALS

A. Cementitious Materials: Use the following cementitious materials, of same type, brand, and source throughout Project:

1. Portland Cement: ASTM C 150/C 150M, white portland cement Type II.

2. Fly Ash: ASTM C 618, Class F.

3. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.

4. Blended Hydraulic Cement: ASTM C 595/C 595M, Type IP, portland-pozzolan cement.

B. Normal-Weight Aggregates: ASTM C 33/C 33M, uniformly graded, conforming to Section 201 of the Standard Specifications for Public Works Construction. Provide aggregates from a single source.

C. Air-Entraining Admixture: ASTM C 260/C 260M.

D. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.

2. Retarding Admixture: ASTM C 494/C 494M, Type B.

3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.

4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.

5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.

6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

E. Color Pigment: ASTM C 979/C 979M, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.

1. Color: As selected by Architect from manufacturer's full range.

F. Water: Potable and complying with ASTM C 94/C 94M.

2.5 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

F. White, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B, dissipating.

2.6 RELATED MATERIALS

A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork in preformed strips.

B. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.

C. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

D. Pigmented Mineral Dry-Shake Hardener: Factory-packaged, dry combination of portland cement, graded quartz aggregate, color pigments, and plasticizing admixture. Use color pigments that are finely ground, nonfading mineral oxides interground with cement.

1. Color: As selected by Architect from manufacturer's full range.

E. Rock Salt: Sodium chloride crystals, kiln dried, coarse gradation with 100 percent passing 3/8-inch sieve and 85 percent retained on a No. 8 sieve.

2.7 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.

2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that comply with or exceed requirements.

B. Cementitious Materials: Use fly ash, pozzolan, slag cement, and silica fume as needed to reduce the total

amount of portland cement, which would otherwise be used, by not less than 40 percent.

C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:

1. Air Content: 3 percent plus or minus 1-1/2 percent for 1-inch nominal maximum aggregate size.

D. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.

E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing admixture in concrete as required for placement and workability.

2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

F. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

G. Concrete Mixtures: Normal-weight concrete.

1 Compressive Strength (28 Days): 3000 psi.

2 Maximum W/C Ratio at Point of Placement:0.50.

3 Slump Limit: 4 inches, plus or minus 1 inch.

2.8 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 -EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.

1 Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.

2 Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.

3 Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Section 312000 "Earth Moving."

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT INSTALLATION

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded-wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

E. Zinc-Coated Reinforcement: Use galvanized-steel wire ties to fasten zinc-coated reinforcement. Repair cut and damaged zinc coatings with zinc repair material.

F. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M.

G. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

A. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

B. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

C. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, to match jointing of existing adjacent concrete paving:

D. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.

B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

H. Screed paving surface with a straightedge and strike off.

I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

J. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.

K. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.

1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.

2. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.

3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.

3.8 SPECIAL FINISHES

A. Monolithic Exposed-Aggregate Finish: Expose coarse aggregate in paving surface as follows:

1. Immediately after float finishing, spray-apply chemical surface retarder to paving according to manufacturer's written instructions.

2. Cover paving surface with plastic sheeting, sealing laps with tape, and remove when ready to continue finishing operations.

3. Without dislodging aggregate, remove mortar concealing the aggregate by lightly brushing surface with a stiff, nylon-bristle broom. Do not expose more than one-third of the average diameter of the aggregate and not more than one-half of the diameter of the smallest aggregate.

4. Fine-spray surface with water and brush. Repeat cycle of water flushing and brushing until cement film is removed from aggregate surfaces to depth required.

B. Seeded Exposed-Aggregate Finish: Immediately after initial floating, spread a single layer of aggregate uniformly on paving surface. Tamp aggregate into plastic concrete and float finish to entirely embed aggregate with mortar cover of 1/16 inch.

1. Spray-apply chemical surface retarder to paving according to manufacturer's written instructions.

2. Cover paving surface with plastic sheeting, sealing laps with tape, and remove sheeting when ready to continue finishing operations.

3. Without dislodging aggregate, remove mortar concealing the aggregate by lightly brushing surface with a stiff, nylon-bristle broom. Do not expose more than one-third of the average diameter of the aggregate and not more than one-half of the diameter of the smallest aggregate.

4. Fine-spray surface with water and brush. Repeat cycle of water flushing and brushing until cement film is removed from aggregate surfaces to depth required.

C. Slip-Resistive Aggregate Finish: Before final floating, spread slip-resistive aggregate finish on paving surface according to manufacturer's written instructions and as follows:

1. Uniformly spread 25 lb/100 sq. ft. of dampened, slip-resistive aggregate over paving surface in two applications. Tamp aggregate flush with surface using a steel trowel, but do not force below surface.

2. Uniformly distribute approximately two-thirds of slip-resistive aggregate over paving surface with mechanical spreader, allow to absorb moisture, and embed by power floating. Follow power floating with a second slip-resistive aggregate application, uniformly distributing remainder of material at right angles to first application to ensure uniform coverage, and embed by power floating.

3. Cure concrete with curing compound recommended by slip-resistive aggregate manufacturer. Apply curing compound immediately after final finishing.

4. After curing, lightly work surface with a steel-wire brush or abrasive stone and water to expose nonslip aggregate.

D. Rock-Salt Finish: After initial floating, uniformly spread rock salt over paving surface at the rate of 5 lb/100 sq. ft..

1. Embed rock salt into plastic concrete with roller or magnesium float.

2. Cover paving surface with 1-mil-thick polyethylene sheet and remove sheet when concrete has hardened and seven-day curing period has elapsed.

3. After seven-day curing period, saturate concrete with water and broom-sweep surface to dissolve remaining rock salt, thereby leaving pits and holes.

E. Pigmented Mineral Dry-Shake Hardener Finish: After initial floating, apply dry-shake materials to paving surface according to manufacturer's written instructions and as follows:

1. Uniformly spread dry-shake hardener at a rate of 100 lb/100 sq. ft. unless greater amount is recommended by manufacturer to match paving color required.

2. Uniformly distribute approximately two-thirds of dry-shake hardener over the concrete surface with mechanical spreader; allow hardener to absorb moisture and embed it by power floating. Follow power floating with a second application of pigmented mineral dry-shake hardener, uniformly distributing remainder of material at right angles to first application to ensure uniform color, and embed hardener by final power floating.

3. After final power floating, apply a hand-troweled finish followed by a broom finish.

4. Cure concrete with curing compound recommended by dry-shake hardener manufacturer. Apply curing compound immediately after final finishing.

3.9 DETECTABLE WARNING INSTALLATION

A. Blockouts: Form blockouts in concrete for installation of detectable paving units specified in Section 321726 "Tactile Warning Surfacing."

1. Tolerance for Opening Size: Plus 1/4 inch, no minus.

B. Cast-in-Place Detectable Warning Tiles: Form blockouts in concrete for installation of tiles specified in Section 321726 "Tactile Warning Surfacing." Screed surface of concrete where tiles are to be installed to elevation, so that edges of installed tiles will be flush with surrounding concrete paving. Embed tiles in fresh concrete to comply with Section 321726 "Tactile Warning Surfacing" immediately after screeding concrete surface.

C. Stamped Detectable Warnings: Install stamped detectable warnings as part of a continuous concrete paving placement and according to stamp-mat manufacturer's written instructions.

1. Before using stamp mats, verify that the vent holes are unobstructed.

2. Apply liquid release agent to the concrete surface and the stamp mat.

3. Stamping: While initially finished concrete is plastic, accurately align and place stamp mats in sequence. Uniformly load, gently vibrate, and press mats into concrete to produce imprint pattern on concrete surface. Load and tamp mats directly perpendicular to the stamp-mat surface to prevent distortion in shape of domes. Press and tamp until mortar begins to come through all of the vent holes. Gently remove stamp mats.

4. Trimming: After 24 hours, cut off the tips of mortar formed by the vent holes.

5. Remove residual release agent according to manufacturer's written instructions, but no fewer than three

days after stamping concrete. High-pressure-wash surface and joint patterns, taking care not to damage stamped concrete. Control, collect, and legally dispose of runoff.

3.10 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

3.11 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:

1. Elevation: 3/4 inch.

2. Thickness: Plus 3/8 inch, minus 1/4 inch.

3. Surface: Gap below 10-feet-long; unleveled straightedge not to exceed 1/2 inch.

4. Joint Spacing: 3 inches.

5. Contraction Joint Depth: Plus 1/4 inch, no minus.

6. Joint Width: Plus 1/8 inch, no minus.

3.12 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing and inspecting of composite samples of fresh concrete obtained according to ASTM C 172/C 172M shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.

   a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C 231/C 231M, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.

5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.

    a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

A. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

B. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7-and 28-day tests.

C. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

D. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.

E. Concrete paving will be considered defective if it does not pass tests and inspections.

F. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

G. Prepare test and inspection reports.

3.13 REPAIR AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.

B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

SECTION 321316 - DECORATIVE CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes colored concrete paving.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for general building applications of concrete.
2. Section 321313 "Concrete Paving" for cast-in-place concrete paving with other finishes, curbs and gutters, and stamped detectable warnings.
3. Section 321373 "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within decorative concrete paving and in joints between decorative concrete paving and other paving or adjacent construction.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to decorative concrete paving, including but not limited to, the following:

a. Concrete mixture design.
b. Quality control of concrete materials and decorative concrete paving construction practices.

2. Require representatives of each entity directly concerned with decorative concrete paving to attend, including the following:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete manufacturer.
d. Decorative concrete paving Installer.
e. Manufacturer's representative of decorative concrete paving system.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Initial Selection: For each type of product, ingredient, or admixture requiring color, pattern, or texture selection.

C. Samples for Verification: For each type of exposed color, pattern, or texture indicated.

D. Design Mixtures: For each decorative concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer and testing agency.

B. Material Certificates: For the following, from manufacturer:

1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Fiber reinforcement.
4. Admixtures.
5. Curing compounds.
6. Applied finish materials.
7. Bonding agent or epoxy adhesive.
8. Joint fillers.

C. Material Test Reports: For each of the following:

1. Aggregates.

D. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer of decorative concrete paving systems.

B. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

C. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups of full-thickness sections of decorative concrete paving to demonstrate typical joints; surface color, pattern, and texture; curing; and standard of workmanship.

2. Build mockups of decorative concrete paving in the location and of the size indicated or, if not indicated, build mockups where directed by Landscape Landscape Architect and not less than 60**inchesby 60 inches.** Retain first subparagraph below if mockups are not only for establishing appearance factors.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Landscape Architect specifically approves such deviations in writing.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified independent testing agency to perform preconstruction testing on decorative concrete paving mixtures.

1.9 FIELD CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:

1. When air temperature has fallen to or is expected to fall below 40 deg F uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg Fand not more than 80 deg Ft point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

C. Hot-Weather Concrete Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg Fat time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap, so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms**,** steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 unless otherwise indicated.

2.2 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

1. Use flexible or uniformly curved forms for curves of a radius of 100 feetor less. Do not use notched and bent forms.

B. Forms for Textured Finish Concrete: Units of face design, size, arrangement, and configuration indicated. Provide solid backing and form supports to ensure stability of textured form liners.

C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.3 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.

B. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 plain-steel bars. Cut bars true to length with ends square and free of burrs.

C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded-wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

2.4 CONCRETE MATERIALS

A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C 150/C 150M, gray portland cement Type I/II.
2. Fly Ash: ASTM C 618, Class C or F.
3. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.
4. Blended Hydraulic Cement: ASTM C 595/C 595M, type IS, portland blast-furnace slag cement.

C. Normal-Weight Aggregates: ASTM C 33/C 33M, Class 4S uniformly graded. Provide aggregates from a single source with documented service-record data of at least 10 years' satisfactory service in similar paving applications and service conditions using similar aggregates and cementitious materials].

1. Maximum Coarse-Aggregate Size: 1 inchnominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Air-Entraining Admixture: ASTM C 260/C 260M.

E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A, colored.
2. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D, colored.
3. Water-Reducing and Accelerating Admixture: ASTM C 494/C 494M, Type E.

F. Color Pigment: ASTM C 979/C 979M, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.

G. Water: Potable and complying with ASTM C 94/C 94M.

2.5 CURING AND SEALING MATERIALS

A. Curing Paper: Nonstaining, waterproof paper, consisting of two layers of kraft paper cemented together and reinforced with fiber, and complying with ASTM C 171.

B. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.

C. Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type I, Class B, manufactured for colored concrete.

1. For integrally colored concrete, curing compound shall be pigmented type approved by coloring admixture manufacturer.
2. For concrete indicated to be sealed, curing compound shall be compatible with sealer.

D. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type I, Class A, manufactured for use with colored concrete.

E. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type I, Class A, manufactured for use with colored concrete.

F. Clear Acrylic Sealer: Manufacturer's standard, waterborne, nonyellowing and UV-resistant, membrane-forming, medium-gloss, acrylic copolymer emulsion solution, manufactured for colored concrete, containing not less than 15 percent solids by volume.

G. Slip-Resistance-Enhancing Additive: Manufacturer's standard finely graded aggregate or polymer additive, designed to be added to clear acrylic sealer to enhance slip resistance of sealed paving surface.

2.6 RELATED MATERIALS

A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork in preformed strips.

B. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

C. Epoxy-Bonding Adhesive: ASTM C 881/C 881M, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements, and of the following types:

1. Types I and II, nonload bearing and Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

D. Polyethylene Film: ASTM D 4397, 1 milthick, clear.

2.7 CONCRETE MIXTURES

A. Obtain each color, size, type, and variety of concrete mixture from single manufacturer with resources to provide concrete of consistent quality in appearance and physical properties.

B. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.

C. Cementitious Materials: Use fly ash, pozzolan, slag cement, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent. Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash or Pozzolan: 25 percent.
2. Slag Cement: 50 percent.
3. Combined Fly Ash or Pozzolan, and Slag Cement: 50 percent, with fly ash or pozzolan not exceeding 25 percent.

D. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
1. Air Content: 4-1/2 percent plus or minus 1.5 percent for 1-inchnominal maximum aggregate size.
2. Air Content: 3-1/2 percent plus or minus 1.5 percent for 3/4-inchnominal maximum aggregate size.

E. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

F. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing admixture, water-reducing and retarding admixture or water-reducing and accelerating admixture in concrete as required for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

G. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

H. Concrete Mixtures: Normal-weight concrete.

1. Compressive Strength 28 Days): 3000 psi
2. Maximum W/C Ratio at Point of Placement: 0.50.
3. Slump Limit: 4 inchesplus or minus 1 inch

2.8 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M. Furnish batch certificates for each batch discharged and used in the Work.

1. When air temperature is between 85 and 90 deg F reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For concrete batches of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For concrete batches larger than 1 cu. yd. increase mixing time by 15 seconds for each additional 1 cu. yd. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below decorative concrete paving to identify soft pockets and areas of excess yielding.

1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph
2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons
3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inchaccording to requirements in Section 312000 "Earth Moving."

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

B. Protect adjacent construction from discoloration and spillage during application of color hardeners, release agents, stains, curing compounds, and sealers.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT INSTALLATION

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded-wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

E. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap to adjacent mats.

3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
2. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
3. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inchesinto concrete.
4. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 40 feetunless otherwise indicated.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler not less than 1/2 inchor more than 1 inchbelow finished surface if joint sealant is indicated.
4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows, to match jointing of existing adjacent decorative concrete paving:

1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-ide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

   a. Tolerance: Ensure that sawed joints are within 3 inchesin both directions from centers of dowels.

2. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 3/8-inchradius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.

B. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

C. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

D. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

E. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

F. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.

G. Screed paving surface with a straightedge and strike off.

H. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

3.8 INTEGRALLY COLORED CONCRETE FINISH

A. Integrally Colored Concrete Finish: After final floating, apply the following finish:
1. Topcast retardant as indicated on plans.

3.9 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x hbefore and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Compound: Apply immediately after final finishing. Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

1. Cure integrally colored concrete with a pigmented curing compound.
2. Cure concrete finished with pigmented mineral dry-shake hardener with a pigmented curing compound.

F. Curing and Sealing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

G. Curing Paper: Cure with unwrinkled curing paper in pieces large enough to cover the entire width and edges of slab. Do not lap sheets. Fold curing paper down over paving edges and secure with continuous banks of earth to prevent displacement or billowing due to wind. Immediately repair holes or tears in paper.

3.10 SEALER APPLICATION

A. Clear Acrylic Sealer: Apply uniformly in two coats in continuous operations according to manufacturer's written instructions. Allow first coat to dry before applying second coat, at 90 degrees to the direction of the first coat, using same application methods and rates.

1. Begin sealing dry surface no sooner than 14 days after concrete placement.
2. Allow stained concrete surfaces to dry before applying sealer.
3. Thoroughly mix slip-resistance-enhancing additive into sealer before applying sealer according to manufacturer's written instructions. Stir sealer occasionally during application to maintain even distribution of additive.

3.11 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:

1. Elevation: 3/4 inch
2. Thickness: Plus 3/8 inch minus 1/4 inch.
3. Surface: Gap below 10-foot-long, unleveled straightedge not to exceed 1/2 inch.
4. Lateral Alignment and Spacing of Dowels: 1 inch.
5. Vertical Alignment of Dowels: 1/4 inch.
6. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
7. Joint Spacing: 3 inches.
8. Contraction Joint Depth: Plus 1/4 inch, no minus.
9. Joint Width: Plus 1/8 inch, no minus.

3.12 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172/C 172M shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.

a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231/C 231M, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg Fand below and when it is 80 deg Fnd above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.

    a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi

D. Test results shall be reported in writing to Landscape Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Landscape Architect but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Landscape Architect.

G. Decorative concrete paving will be considered defective if it does not pass tests and inspections.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

I. Prepare test and inspection reports.

3.13 REPAIR AND PROTECTION

A. Remove and replace decorative concrete paving that is broken or damaged or does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Landscape Architect.

B. Detailing: Grind concrete "squeeze" left from tool placement. Color ground areas with slurry of color hardener mixed with water and bonding agent. Remove excess release agent with high-velocity blower.

C. Protect decorative concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain decorative concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

3.14 DECORATIVE CONCRETE PAVING SCHEDULE

A. Decorative Concrete Paving :

1. Locations: As indicated on plans.
2. Coloring Method: Integrally colored.

a. Color: As indicated on plans

3. Field Patterning Method: **Top Cast Retardant**

a. Texture/Etch depth: As indicated on plan.

END OF SECTION 321316

SECTION 321373 – CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cold-applied joint sealants.
2. Hot-applied joint sealants.
3. Joint-sealant backer materials.
4. Primers.

B. Related Requirements:

1. Section 079200 "Joint Sealants" for sealing nontraffic and traffic joints in locations not specified in this Section.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

C. Paving-Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of joint sealant and accessory.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Product Testing: Test joint sealants using a qualified testing agency.

1.7 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 -PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

2.2 COLD-APPLIED JOINT SEALANTS

A. Single-Component, Nonsag, Silicone Joint Sealant: ASTM D 5893/D 5893M, Type NS.

B. Single-Component, Self-Leveling, Silicone Joint Sealant: ASTM D 5893/D 5893M, Type SL.

C. Multicomponent, Nonsag, Urethane, Elastomeric Joint Sealant: ASTM C 920, Type M, Grade NS, Class 25, for Use T.

D. Single Component, Pourable, Urethane, Elastomeric Joint Sealant: ASTM C 920, Type S, Grade P, Class 25, for Use T.

E. Multicomponent, Pourable, Urethane, Elastomeric Joint Sealant: ASTM C 920, Type M, Grade P, Class 25, for Use T.

2.3 HOT-APPLIED JOINT SEALANTS

A. Hot-Applied, Single-Component Joint Sealant: ASTM D 6690, Type I.

B. Hot-Applied, Single-Component Joint Sealant: ASTM D 6690, Type I or Type II.

C. Hot-Applied, Single-Component Joint Sealant: ASTM D 6690, Type I, II, or III.

D. Hot-Applied, Single-Component Joint Sealant: ASTM D 6690, Type IV.

2.4 JOINT-SEALANT BACKER MATERIALS

A. Joint-Sealant Backer Materials: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by joint-sealant manufacturer, based on field experience and laboratory testing.

B. Round Backer Rods for Cold-and Hot-Applied Joint Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

C. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D 5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.

D. Backer Strips for Cold-and Hot-Applied Joint Sealants: ASTM D 5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

2.5 PRIMERS

A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated.

PART 3 -EXECUTION

3.1 EXAMINATION

A. Examine joints to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Before installing joint sealants, clean out joints immediately to comply with joint-sealant manufacturer's written instructions.

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS

A. Comply with joint-sealant manufacturer's written installation instructions for products and applications indicate ed unless more stringent requirements apply.

B. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions.

C. Install joint-sealant backings to support joint sealants during application and at position required to produce
1. cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

2. Do not leave gaps between ends of joint-sealant backings.
3. Do not stretch, twist, puncture, or tear joint-sealant backings.
4. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install joint sealants immediately following backing installation, using proven techniques that comply with the following:

1. Place joint sealants so they fully contact joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants according to the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:

1. Remove excess joint sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

3.4 CLEANING AND PROTECTION

A. Clean off excess joint sealant as the Work progresses, by methods and with cleaning materials approved in writing by joint-sealant manufacturers.

B. Protect joint sealants, during and after curing period, from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.

3.5 PAVING-JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Joints within concrete paving.

1. Joint Location:

a. Expansion and isolation joints in concrete paving.
b. Contraction joints in concrete paving.
c. Other joints as indicated.

2. Joint Sealant: Single-component, self-leveling, silicone joint sealant.
3. Joint-Sealant Color: Manufacturer's standard.

B. Joint-Sealant Application: Joints within concrete paving and between concrete and asphalt paving.

1. Joint Location:

a. Joints between concrete and asphalt paving.
b. Joints between concrete curbs and asphalt paving.

c. Other joints as indicated.
2. Joint Sealant: Hot-applied, single-component joint sealant.
3. Joint-Sealant Color: Manufacturer's standard.

1.1 END OF SECTION 321373

SECTION 321400 - UNIT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Concrete pavers set in mortar setting beds.
2. Aluminum edge restraints.
3. Cast-in-place concrete edge restraints.

B. Related Requirements:

1. Section 321313 "Concrete Paving" for concrete base under unit pavers and for cast-in-place concrete curbs and gutters serving as edge restraints for unit pavers.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For materials other than water and aggregates.

B. Product Data: For the following:

1. Pavers.
2. Mortar and grout materials.
3. Edge restraints.

C. Sieve Analyses: For aggregate setting-bed materials, according to ASTM C 136.

D. Samples for Initial Selection: For each type of unit paver indicated and the following:

1. Joint materials involving color selection.
2. Exposed edge restraints involving color selection.
3. Precast concrete curbs.

E. Samples for Verification: For full-size units of each type of unit paver indicated.

1. Joint materials.
2. Exposed edge restraints.

1.5 INFORMATIONAL SUBMITTALS

A. Adhesion and Compatibility Test Reports: From latex-additive manufacturer for mortar and grout containing latex additives.

B. Material Certificates: For unit pavers. Include statements of material properties indicating compliance with requirements, including compliance with standards. Provide for each type and size of unit.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for unit pavers, indicating compliance with requirements.

1. For solid interlocking paving units, include test data for freezing and thawing according to ASTM C 67.

1.6 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Submit to latex-additive manufacturer, for testing as indicated below, Samples of flooring materials that will contact or affect mortar and grout that contain latex additives.

1. Use manufacturer's standard test methods to determine whether mortar and grout materials will obtain optimal adhesion with, and will be nonstaining to, installed brick and other materials constituting brick flooring installation.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store pavers on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Store liquids in tightly closed containers protected from freezing.

E. Store asphalt cement and other bituminous materials in tightly closed containers.

1.9 FIELD CONDITIONS

A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.

B. Weather Limitations for Mortar and Grout:

1. Cold-Weather Requirements: Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6. Provide artificial shade and windbreaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F and higher.

    a. When ambient temperature exceeds 100 deg F, or when wind velocity exceeds 8 mph and ambient temperature exceeds 90 deg F, set pavers within 1 minute of spreading setting-bed mortar.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain each type of unit paver, joint material, and setting material from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

B. Concrete Pavers: Solid paving units made from normal-weight concrete with a compressive strength not less than 10,000 psi, water absorption not more than 5 percent according to ASTM C 140, and no breakage and not more than 1 percent mass loss when tested for freeze-thaw resistance according to ASTM C 67.

1. Concrete Collaborative – Trails Paver, Finish: Flek
2. Thickness: 1 inch and 2 inches.
3. Face Size and Shape: 24 inches square.
4. Face Size and Shape: 12-by-24-inch rectangle.
5. Color: Pearl, Nassau

2.2 CURBS AND EDGE RESTRAINTS

A. Job-Built Concrete Edge Restraints: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mixed concrete with minimum 28-day compressive strength of 3000 psi.

2.3 ACCESSORIES

A. Cork Joint Filler: Preformed strips complying with ASTM D 1752, Type II.

B. Compressible Foam Filler: Preformed strips complying with ASTM D 1056, Grade 2A1.

2.4 MORTAR SETTING-BED MATERIALS

A. Thin-Set Mortar for Bond Coat: Latex-portland cement mortar complying with ANSI A118.4.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. LATICRETE SUPERCAP, LLC. – Laticrete 254R Platinum Rapid, use Laticrete 253 in heat over 95 degrees F.

2.5 GROUT MATERIALS

A. High-Performance Cement Grout: ANSI A118.7, sanded.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. LATICRETE SUPERCAP, LLC.

B. Grout Colors: As selected by Architect from manufacturer's full range.

C. Water: Potable.

2.6 MORTAR AND GROUT MIXES

A. General: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing times, and other procedures needed to produce setting-bed and joint materials of uniform quality and with optimal performance characteristics. Discard mortars and grout if they have reached their initial set before being used.

B. Thinset Mortar Bond Coat: Proportion and mix according to manufacturer's written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces indicated to receive unit paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Where unit paving is to be installed over waterproofing, examine waterproofing installation, with waterproofing Installer present, for protection from paving operations, including areas where waterproofing system is turned up or flashed against vertical surfaces.

C. Proceed with installation only after unsatisfactory conditions have been corrected and waterproofing protection is in place.

3.2 PREPARATION

A. Remove substances from concrete substrates that could impair mortar bond, including curing and sealing compounds, form oil, and laitance.

B. Sweep concrete substrates to remove dirt, dust, debris, and loose particles.

C. Proof-roll prepared subgrade according to requirements in Section 312000 "Earth Moving" to identify soft pockets and areas of excess yielding. Proceed with unit paver installation only after deficient subgrades have been corrected and are ready to receive subbase and base course for unit pavers.

3.3 INSTALLATION, GENERAL

A. Do not use unit pavers with chips, cracks, voids, discolorations, or other defects that might be visible or cause staining in finished work.

B. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.

C. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.

1. For concrete pavers, a block splitter may be used.

D. Handle protective-coated brick pavers to prevent coated surfaces from contacting backs or edges of other units. If, despite these precautions, coating does contact bonding surfaces of brick, remove coating from bonding surfaces before setting brick.

E. Joint Pattern: As indicated

F. Pavers over Waterproofing: Exercise care in placing pavers and setting materials over waterproofing so protection materials are not displaced and waterproofing is not punctured or otherwise damaged. Carefully replace protection materials that become displaced and arrange for repair of damaged waterproofing before covering with paving.

1. Provide joint filler at waterproofing that is turned up on vertical surfaces.

G. Tolerances: Do not exceed 1/32-inch unit-to-unit offset from flush (lippage) or 1/8 inch in 10 feet from level, or indicated slope, for finished surface of paving.

H. Tolerances: Do not exceed 1/4 inch in 10 feet from level, or indicated slope, for finished surface of paving.

I. Expansion and Control Joints: Provide for sealant-filled joints at locations and of widths indicated. Provide compressible foam filler as backing for sealant-filled joints . Install joint filler before setting pavers. Sealant materials and installation are specified in Section 079200 "Joint Sealants."

J. Expansion and Control Joints: Provide cork joint filler at locations and of widths indicated. Install joint filler before setting pavers. Make top of joint filler flush with top of pavers.

K. Provide edge restraints as indicated on plans. Install edge restraints before placing unit pavers.

1. Install edge restraints to comply with manufacturer's written instructions. Install stakes at intervals required to hold edge restraints in place during and after unit paver installation.
2. Install job-built concrete edge restraints to comply with requirements in Section 033000 "Cast-in-Place Concrete."

3.4 MORTAR SETTING-BED APPLICATIONS

A. Saturate concrete subbase with clean water several hours before placing setting bed. Remove surface water about one hour before placing setting bed.

B. Apply mortar-bed bond coat over surface of concrete subbase about 15 minutes before placing mortar bed. Do not exceed 1/16-inch thickness for bond coat. Limit area of bond coat to avoid its drying out before placing setting bed.

C. Mix and place only that amount of mortar bed that can be covered with pavers before initial set. Before placing pavers, cut back, bevel edge, and remove and discard setting-bed material that has reached initial set.

D. Place pavers before initial set of cement occurs. Immediately before placing pavers on mortar bed, apply uniform 1/16-inch- thick bond coat to mortar bed or to back of each paver with a flat trowel.

E. Tamp or beat pavers with a wooden block or rubber mallet to obtain full contact with setting bed and to bring finished surfaces within indicated tolerances. Set each paver in a single operation before initial set of mortar; do not return to areas already set or disturb pavers for purposes of realigning finished surfaces or adjusting joints.

F. Spaced Joint Widths: Provide nominal joint width with variations not exceeding plus or minus 1/8 inch.

G. Grouted Joints: Grout paver joints complying with ANSI A108.10.

3.5 REPAIRING, POINTING, AND CLEANING

A. Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.

B. Pointing: During tooling of joints, enlarge voids or holes and completely fill with grout. Point joints at sealant joints to provide a neat, uniform appearance, properly prepared for sealant application.

C. Cleaning: Remove excess grout from exposed paver surfaces; wash and scrub clean.

1. Remove temporary protective coating as recommended by coating manufacturer and as acceptable to paver and grout manufacturers.
2. Do not allow protective coating to enter floor drains. Trap, collect, and remove coating material.

END OF SECTION 321400

SECTION 321723 – PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes painted markings applied to asphalt and concrete pavement.

B. Related Requirements:
1. Section 099113 "Exterior Painting" for painting exterior concrete surfaces other than pavement.

2. Section 099123 "Interior Painting" for painting interior concrete surfaces other than pavement.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to marking pavement including, but not limited to, the following:
a. Pavement aging period before application of pavement markings.
b. Review requirements for protecting pavement markings, including restriction of traffic during installation period.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include technical data and tested physical and performance properties.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of Standard Specifications of CalTrans for pavement-marking work.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for alkyd materials or 55 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 PAVEMENT-MARKING PAINT

A. Pavement-Marking Paint: Alkyd-resin type, lead and chromate free, ready mixed, complying with AASHTO M 248; colors complying with FS TT-P-1952.

1. Color: As indicated.

B. Pavement-Marking Paint: MPI #32, alkyd traffic-marking paint.

1. Color: As indicated.

C. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, Type II, with drying time of less than three minutes.

1. Color: As indicated.

D. Pavement-Marking Paint: MPI #97, latex traffic-marking paint.

1. Color: As indicated.

E. Glass Beads: AASHTO M 247, Type 1 made of 100 percent recycled glass.

1. Roundness: Minimum 75 percent true spheres by weight.

PART 3 -EXECUTION

3.1 EXAMINATION

A. Verify that pavement is dry and in suitable condition to begin pavement marking according to manufacturer's written instructions.

B. Proceed with pavement marking only after unsatisfactory conditions have been corrected.

3.2 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow paving to age for a minimum of 30 days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to pavement. Mask an extended area beyond edges of each stencil to prevent paint application beyond the stencil. Apply paint so that it cannot run beneath the stencil.

2. Broadcast glass beads uniformly into wet markings at a rate of 6 lb/gal.

3.3 PROTECTING AND CLEANING

A. Protect pavement markings from damage and wear during remainder of construction period.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 321723

SECTION 321726 – TACTILE WARNING SURFACING

PART 1 -GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Surface-applied detectable warning tiles.

2. Detectable warning mats.

A. Related Requirements:

1. Section 321313 "Concrete Paving" for concrete walkways serving as substrates for tactile warning surfacing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification: For each type of tactile warning surface, in manufacturer's standard sizes unless otherwise indicated, showing edge condition, truncated-dome pattern, texture, color, and cross section; with fasteners and anchors.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For tactile warning surfacing, to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.7 PROJECT CONDITIONS

A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds.

B. Weather Limitations for Adhesive Application:

1. Apply adhesive only when ambient temperature is above 50 deg F and when temperature has not been below 35 deg F for 12 hours immediately before application. Do not apply when substrate is wet or contains excess moisture.

C. Weather Limitations for Mortar and Grout:

1. Cold-Weather Requirements: Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602. Provide artificial shade and windbreaks, and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F and higher.

   a. When ambient temperature exceeds 100 deg F, or when wind velocity exceeds 8 mph and ambient temperature exceeds 90 deg F, set unit pavers within 1 minute of spreading setting-bed mortar.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of tactile warning surfaces that fail in materials or workmanship within specified warranty period.

   1. Failures include, but are not limited to, the following:

      a. Deterioration of finishes beyond normal weathering and wear.

      b. Separation or delamination of materials and components.

   2. Warranty Period: Five years from date of Substantial Completion.

PART 2 -PRODUCTS

2.1 TACTILE WARNING SURFACING, GENERAL

A. Accessibility Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities for tactile warning surfaces.

1. For tactile warning surfaces composed of multiple units, provide units that when installed provide consistent side-to-side and end-to-end dome spacing that complies with requirements.

B. Source Limitations: Obtain each type of tactile warning surfacing from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

2.2 DETECTABLE WARNING TILES

A. Cast-in-Place Detectable Warning Tiles: Accessible truncated-dome detectable warning tiles with replaceable surface configured for setting flush in new concrete walkway surfaces, with slip-resistant surface treatment on domes and field of tile.

   1. Material: Cast-fiber-reinforced polymer concrete tile or Molded glass-and carbon-fiber-reinforced polyester.

   2. Color: As selected by Architect from manufacturer's full line.

   3. Shapes and Sizes:

      a. Rectangular panel, 12 by 12 inches, 24 by 24 inches, 24 by 36 inches, 24 by 48 inches, 36 by 48 inches or 36 by 60 inches as needed.

   4. Dome Spacing and Configuration: Manufacturer's standard compliant spacing in manufacturer's standard pattern.

   5. Mounting:

      a. Permanently embedded detectable warning tile wet-set into freshly poured concrete.

b. Detectable warning tile set into formed recess in concrete and adhered with mortar.

c. Replaceable detectable warning tile wet-set into freshly poured concrete and surface-fastened to permanently embedded anchors.

B. Surface-Applied Detectable Warning Tiles: Accessible truncated-dome detectable warning concrete tiles configured for surface application on existing concrete walkway surfaces, with slip-resistant surface treatment on domes, field of tile, and beveled outside edges.

1. Material: Cast-fiber-reinforced polymer concrete tile or Molded glass-and carbon-fiber-reinforced polyester.

2. Color: As selected by Architect from manufacturer's full line.

3. Shapes and Sizes:

a. Rectangular panel, 12 by 12 inches, 24 by 24 inches, 24 by 36 inches, 24 by 48 inches, 36 by 48 inches or 36 by 60 inches.

4. Dome Spacing and Configuration: Manufacturer's standard compliant spacing in manufacturer's standard pattern.

5. Mounting: Adhered and fastened to existing concrete walkway.

2.3 DETECTABLE WARNING MATS

A. Surface-Applied Detectable Warning Mats: Accessible truncated-dome detectable warning resilient mats, UV resistant, manufactured for adhering to existing concrete walkway surfaces, with slip-resistant surface treatment on domes, field of mat, and beveled outside edges.

1. Material: Modified rubber compound, UV resistant.

2. Color: As selected by Architect from manufacturer's full range.

3. Shapes and Sizes:

a. Rectangular panel, 24 by 36 inches or 24 by 48 inches as needed.

4. Dome Spacing and Configuration: Manufacturer's standard compliant spacing in manufacturer's standard pattern.

5. Mounting: Adhered to pavement surface with adhesive and fastened with fasteners.

2.4 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of tactile warning surfaces, noncorrosive and compatible with each material joined, and complying with the following:

1. Furnish Type 316 stainless-steel fasteners for exterior use.

2. Fastener Heads: For nonstructural connections, use flathead or oval countersunk screws and bolts with tamper-resistant heads, colored to match tile.

A. Adhesive: As recommended by manufacturer for adhering tactile warning surfacing unit to pavement.

B. Sealant: As recommended by manufacturer for sealing perimeter of tactile warning surfacing unit.

PART 3 -EXECUTION

3.1 EXAMINATION

A. Verify that pavement is in suitable condition to begin installation according to manufacturer's written instructions. Verify that installation of tactile warning surfacing will comply with accessibility requirements upon completion.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF TACTILE WARNING SURFACING

A. General: Prepare substrate and install tactile warning surfacing according to manufacturer's written instructions unless otherwise indicated.

B. Place tactile warning surfacing units in dimensions and orientation indicated. Comply with location requirements of AASHTO MP 12.

3.3 INSTALLATION OF DETECTABLE WARNING TILES

A. Cast-in-Place Detectable Warning Tiles:

1. Concrete Paving Installation: Comply with installation requirements in Section 321313 "Concrete Paving." Mix, place, and finish concrete to conditions complying with detectable warning tile manufacturer's written requirements for satisfactory embedment of tile.

2. Set each detectable warning tile accurately and firmly in place and completely seat tile back and embedments in wet concrete by tamping or vibrating. If necessary, temporarily apply weight to tiles to ensure full contact with concrete.

3. Set surface of tile flush with surrounding concrete and adjacent tiles, with variations between tiles and between concrete and tiles not exceeding plus or minus 1/8 inch from flush.

4. Protect exposed surfaces of installed tiles from contact with wet concrete. Complete finishing of concrete paving surrounding tiles. Remove concrete from tile surfaces.

5. Clean tiles using methods recommended in writing by manufacturer.

B. Removable Cast-in-Place Detectable Warning Tiles:

1. Concrete Paving Installation: Comply with installation requirements in Section 321313 "Concrete Paving." Mix, place, and finish concrete to conditions complying with detectable warning tile manufacturer's written requirements for satisfactory embedment of removable tile.

2. Set each detectable warning tile accurately and firmly in place with embedding anchors and fasteners attached, and firmly seat tile back in wet concrete by tamping or vibrating. If necessary, temporarily apply weight to tiles to ensure full contact with concrete.

3. Set surface of tile flush with surrounding concrete and adjacent tiles, with variations between tiles and between concrete and tiles not exceeding plus or minus 1/8 inch from flush.

4. Protect exposed surfaces of installed tiles from contact with wet concrete. Complete finishing of concrete paving surrounding tiles. Remove concrete from tile surfaces.

5. Clean tiles using methods recommended in writing by manufacturer.

C. Surface-Applied Detectable Warning Tiles:

1. Lay out detectable warning tiles as indicated and mark concrete pavement.

2. Prepare existing paving surface by grinding and cleaning as recommended by manufacturer.

   a. Cut perimeter kerf in existing concrete pavement to receive metal tile flange.

3. Apply adhesive to back of tiles in amounts and pattern recommended by manufacturer, and set tiles in place. Firmly seat tiles in adhesive bed, eliminating air pockets and establishing full adhesion to pavement. If necessary, temporarily apply weight to tiles to ensure full contact with concrete.

4. Install anchor devices through face of tiles and into pavement using anchors located as recommended by manufacturer. Set heads of anchors flush with top surface of mat.

5. Mask perimeter of tiles and adjacent concrete, and apply sealant in continuous bead around perimeter of tile installation.

6. Remove masking, adhesive, excess sealant, and soil from exposed surfaces of detectable warning tiles and surrounding concrete pavement using cleaning agents recommended in writing by manufacturer.

7. Protect installed tiles from traffic until adhesive has set.

3.4 INSTALLATION OF DETECTABLE WARNING MATS

A. Lay out detectable warning mats as indicated and mark concrete pavement at edges of mats.

B. Prepare existing paving surface by grinding and cleaning as recommended by manufacturer.

C. Apply adhesive to back of mat in amounts and pattern recommended by manufacturer, and set mat in place. Firmly seat mat in adhesive bed, eliminating air pockets and establishing full adhesion to pavement. If necessary, temporarily apply weight to mat to ensure full contact with adhesive.

D. Install anchor devices through face of mat and into pavement using anchors located as recommended by manufacturer. Set heads of anchors flush with mat surface.

E. Mask mat perimeter and adjacent concrete, and apply sealant in continuous bead around perimeter of mat.

F. Remove masking, adhesive, excess sealant, and soil from exposed surfaces of detectable warning mat and surrounding concrete pavement using cleaning agents recommended in writing by manufacturer.

G. Protect installed mat from traffic until adhesive has set.

3.5 CLEANING AND PROTECTION

A. Remove and replace tactile warning surfacing that is broken or damaged or does not comply with requirements in this Section. Remove in complete sections from joint to joint unless otherwise approved by Architect. Replace using tactile warning surfacing installation methods acceptable to Architect.

B. Protect tactile warning surfacing from damage and maintain free of stains, discoloration, dirt, and other foreign material.

END OF SECTION 321726

SECTION 323119 - DECORATIVE METAL FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Horizontal-slide gates.

B. Related Requirements:

   1. Section 033000 "Cast-in-Place Concrete" for post concrete fill.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For gates. Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each fence material and for each color specified.

   1. Provide Samples 12 inches in length for linear materials.
   2. Provide Samples 12 inches square for bar grating and sheet or plate materials.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Product Test Reports: For decorative metallic-coated-steel tubular picket fences, including finish, indicating compliance with referenced standard and other specified requirements.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

   1. Include 10-foot length of fence complying with requirements.

2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 DECORATIVE STEEL FENCES WITH WOOD PLANKING

A. Decorative Steel Fences: Fences made from steel tubing and shapes, hot-dip galvanized.

B. Posts: Round steel tubing.
1. Horizontal-Slide Gate Post, Openings up to 12 Feet: 3 inches with 3/16-inch wall thickness.

C. Gate Track:
1. Horizontal-Slide Gate Top Rail: shall be Adaptrack Top Rail by Ameristar or equal.
2. Horizontal-Slide Gate Top Track Truck Bracket: shall be Adaptrack Truck Bracket by Ameristar or equal.

D. Post Caps: Formed from steel sheet and hot-dip galvanized after forming.

E. Gate Frame:

1. Steel Tube Rails: Square steel tubing 2 by 2 inches with 1/8-inch wall thickness.

F. Wood Planking:

1. 1” X 4” western red cedar planking, #1 or better.

G. Fasteners: Stainless-steel self tapping screws.

H. Finish exposed welds to comply with NOMMA Guideline 1, Finish #4 - good-quality, uniform undressed weld with minimal splatter.

I. Galvanizing: For items other than hardware that are indicated to be galvanized, hot-dip galvanize to comply with ASTM A 123/A 123M. For hardware items, hot-dip galvanize to comply with ASTM A 153/A 153M.

1. Hot-dip galvanize posts and rails.
2. Hot-dip galvanize rail and picket assemblies after fabrication.
3. Hot-dip galvanize bar grating infill after fabrication.
4. Hot-dip galvanize custom-design rail and infill assemblies after fabrication.

2.2 COATING MATERIALS

A. Shop Primers for Steel: Provide primers that comply with Section 099600 "High-Performance Coatings."

2.3 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Concrete: Normal-weight, air-entrained, ready-mix concrete complying with requirements in Section 033000 "Cast-in-Place Concrete" with a minimum 28-day compressive strength of 3000 psi, 3-inch slump, and 1-inch maximum aggregate size or dry, packaged, normal-weight concrete mix complying with ASTM C 387/C 387M mixed with potable water according to manufacturer's written instructions.

C. Nonshrink Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M and specifically recommended by manufacturer for exterior applications.

2.4 STEEL FINISHES

A. Surface Preparation: Clean surfaces according to SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning."

1. After cleaning, apply a conversion coating compatible with the organic coating to be applied over it.

B. Primer Application: Apply zinc-rich epoxy primer immediately after cleaning, to provide a minimum dry film thickness of 2 mils per applied coat, to surfaces that are exposed after assembly and installation, and to concealed surfaces.

C. High-Performance Coating: Apply intermediate and polyurethane topcoats to prime-coated surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Apply at spreading rates recommended by coating manufacturer.

1. Match approved Samples for color, texture, and coverage. Remove and refinish, or recoat work that does not comply with specified requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, construction layout, and other conditions affecting performance of the Work.

B. Do not begin installation before final grading is completed unless otherwise permitted by Architect.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

1. Construction layout and field engineering are specified in Section 017300 "Execution."

3.3 DECORATIVE FENCE INSTALLATION

A. Install fences according to manufacturer's written instructions.

B. Install fences by setting posts as indicated and fastening rails and infill panels to posts. Peen threads of bolts after assembly to prevent removal.

C. Post Excavation: Drill or hand-excavate holes for posts in firm, undisturbed soil. Excavate holes to a diameter of not less than 4 times post size and a depth of not less than 24 inches plus 3 inches for each foot or fraction of a foot that fence height exceeds 4 feet.

D. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.

1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
2. Concrete Fill: Place concrete around posts and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.

    a. Exposed Concrete: Extend 2 inches above grade. Finish and slope top surface to drain water away from post.
    b. Concealed Concrete: Top below grade as indicated on Drawings to allow covering with surface material. Slope top surface of concrete to drain water away from post.

3. Posts Set in Concrete: Extend post to within 6 inches of specified excavation depth, but not closer than 3 inches to bottom of concrete.
4. Posts Set into Concrete in Sleeves: Use galvanized-steel pipe sleeves with inside diameter at least 3/4 inch larger than outside diagonal dimension of post, preset and anchored into concrete for installing posts.

    a. Extend posts at least 5 inches into sleeve.
    b. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink grout, mixed and placed to comply with grout manufacturer's written instructions; shape and smooth to shed water. Finish and slope top surface of grout to drain water away from post.

3.4 GATE INSTALLATION

A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.5 ADJUSTING

A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Lubricate hardware and other moving parts.

END OF SECTION 323119

SECTION 324000 - LANDSCAPE PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Steel pipe and tube railings.
2. Aluminum pipe and tube railings.
3. Stainless-steel pipe and tube railings.

B. Related Requirements:

1. Section 057300 "Decorative Metal Railings" for ornamental railings fabricated from pipes and tubes.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Manufacturer's product lines of mechanically connected railings.
2. Railing brackets.
3. Grout, anchoring cement, and paint products.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
2. Fittings and brackets.
3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.

a. Show method of connecting and finishing members at intersections.

D. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.

D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

E. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

F. Evaluation Reports: For post-installed anchors, from ICC-ES.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.

B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ ft. applied in any direction.
b. Concentrated load of 200 lbf applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
b. Infill load and other loads need not be assumed to act concurrently.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F ambient; 180 deg F material surfaces.

2.2 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

1. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt or predrilled hole for exposed bolt anchorage and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface or as indicated on plans.

2.3 STEEL AND IRON

A. Retain material types, qualities, and grades in remaining paragraphs that are indicated in Specifications or on Drawings.

B. Tubing: ASTM A 500 (cold formed) or ASTM A 513.

C. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

1. Provide galvanized finish for exterior installations and where indicated.

D. Plates, Shapes, and Bars: ASTM A 36/A 36M.

E. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

F. Expanded Metal: ASTM F 1267, Type I (expanded), Class 1 (uncoated).

G. Perforated Metal: Cold-rolled steel sheet, ASTM A 1008/A 1008M, or hot-rolled steel sheet, ASTM A 1011/A 1011M, commercial steel Type B, 0.060 inch thick, with 1/4-inch holes 3/8 inch o.c. in staggered rows.

H. Perforated Metal: Galvanized-steel sheet, ASTM A 653/A 653M, G90 (Z275) coating, commercial steel Type B, 0.064 inch thick, with 1/4-inch holes 3/8 inch o.c. in staggered rows with 1/8-by-1-inch round end slotted holes in staggered rows.

I. Woven-Wire Mesh: Intermediate-crimp, **diamond** pattern, 2-inch woven-wire mesh, made from 0.134-inch-diameter wire complying with ASTM A 510 (ASTM A 510M).

2.4 ALUMINUM

A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.

B. Extruded Bars and Tubing]: ASTM B 221 (ASTM B 221M), Alloy 6063-T5/T52.

C. Extruded Structural Pipe and Round Tubing: ASTM B 429/B 429M, Alloy 6063-T6.

1. Provide Standard Weight (Schedule 40) pipe unless otherwise indicated.

D. Drawn Seamless Tubing: ASTM B 210 (ASTM B 210M), Alloy 6063-T832.

E. Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 6061-T6.

F. Die and Hand Forgings: ASTM B 247 (ASTM B 247M), Alloy 6061-T6.

G. Castings: ASTM B 26/B 26M, Alloy A356.0-T6.

H. Perforated Metal: Aluminum sheet, ASTM B 209 (ASTM B 209M), Alloy 6061-T6, 0.063 inch thick, with 1/4-inch holes 3/8 inch o.c. in staggered rows.

I. Woven-Wire Mesh: Intermediate-crimp, **diamond** pattern, 2-inch woven-wire mesh, made from 0.162-inch-diameter wire complying with ASTM B 211 (ASTM B 211M), Alloy 6061-T94.

2.5 STAINLESS STEEL

A. Tubing: ASTM A 554, Grade MT 304.

B. Pipe: ASTM A 312/A 312M, Grade TP 304.

C. Castings: ASTM A 743/A 743M, Grade CF 8 or CF 20.

D. Plate and Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304.

E. Expanded Metal: ASTM F 1267, Type I (expanded), Class 3 (corrosion-resistant steel), made from stainless-steel sheet, ASTM A 240/A 240M or ASTM A 666, Type 304.

F. Perforated Metal: Stainless-steel sheet, ASTM A 240/A 240M or ASTM A 666, Type 304, 0.062 inch thick, with 1/4-inch holes 3/8 inch o.c. in staggered rows.

G. Woven-Wire Mesh: Intermediate-crimp, diamond pattern, 2-inch woven-wire mesh, made from 0.141-inch-diameter wire complying with ASTM A 580/A 580M, Type 304.

2.6 FASTENERS

A. General: Provide the following:

1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5 for zinc coating.
2. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.
3. Aluminum Railings: Type 304 stainless-steel fasteners.
4. Stainless-Steel Railings: Type 304 stainless-steel fasteners.
5. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Fasteners for Interconnecting Railing Components:

1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
2. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
3. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy [Group 2 (A4) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

2.7 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

1. For aluminum and stainless-steel railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

B. Etching Cleaner for Galvanized Metal: Complying with MPI#25.

C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

D. Shop Primers: Provide primers that comply with Section 099600 "High-Performance Coatings."

E. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

F. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

G. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

H. Intermediate Coats and Topcoats: Provide products that comply with Section 099600 "High-Performance Coatings."

I. Epoxy Intermediate Coat: Complying with MPI #77 and compatible with primer and topcoat.

J. Polyurethane Topcoat: Complying with MPI #72 and compatible with undercoat.

K. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

L. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

M. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

1. Water-Resistant Product: At exterior locations and where indicated provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.8 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with either welded or nonwelded connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

I. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.

J. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.

K. Form Changes in Direction as Follows:

1. As detailed.

L. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

M. Close exposed ends of railing members with prefabricated end fittings.

N. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.

O. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

P. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

Q. For railing posts set in concrete, provide stainless-steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.

R. For removable railing posts, fabricate slip-fit sockets from stainless-steel tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height. Provide socket covers designed and fabricated to resist being dislodged.

1. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.

S. Expanded-Metal Infill Panels: Fabricate infill panels from expanded metal made from same metal as railings in which they are installed.

1. Edge panels with U-shaped channels made from metal sheet, of same metal as expanded metal and not less than 0.043 inch thick.
2. Orient expanded metal with long dimension of diamonds as indicated on Drawings.

T. Perforated-Metal Infill Panels: Fabricate infill panels from perforated metal made from same metal as railings in which they are installed.

1. Edge panels with U-shaped channels made from metal sheet, of same metal as perforated metal and not less than 0.043 inch thick.
2. Orient perforated metal with pattern as indicated on Drawings.

U. Woven-Wire Mesh Infill Panels: Fabricate infill panels from woven-wire mesh crimped into 1-by-1/2-by-1/8-inch metal channel frames. Make wire mesh and frames from same metal as railings in which they are installed.

1. Orient wire mesh with as indicated on Drawings.

V. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.9 STEEL AND IRON FINISHES

A. Galvanized Railings:

1. Hot-dip galvanize **exterior** steel railings, including hardware, after fabrication.
2. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
3. Comply with ASTM A 153/A 153M for hot-dip galvanized hardware.
4. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
5. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.

D. For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves; however, galvanize anchors to be embedded in exterior concrete or masonry.

E. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with requirements indicated below:

1. Exterior Railings: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Railings Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
3. Railings Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
4. Other Railings: SSPC-SP 3, "Power Tool Cleaning."

F. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

1. Shop prime uncoated railings with primers specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" unless zinc-rich primer or primers specified in Section 099600 "High-Performance Coatings" are indicated.
2. Do not apply primer to galvanized surfaces.

G. Shop-Painted Finish: Comply with Section 099600 "High-Performance Coatings."

1. Color: As selected by Landscape Architect from manufacturer's full range.

H. High-Performance Coating: Apply epoxy intermediate and polyurethane topcoats to prime-coated surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," for shop painting. Apply at spreading rates recommended by coating manufacturer.

1. Color: As selected by Landscape Architect from manufacturer's full range.

2.10 ALUMINUM FINISHES

A. 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 unacceptable. 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.

B. Mill Finish: AA-M12, nonspecular as fabricated.

C. Clear Anodic Finish: AAMA 611.

D. Color Anodic Finish: AAMA 611.
1. As selected by Landscape Architect from full range of industry colors and color densities.

E. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: As selected by Landscape Architect from manufacturer's full range >.

F. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604 and containing not less than 50 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As selected by Landscape Architect from manufacturer's full range.

G. High-Performance Organic Finish: Three coat fluoropolymer finish complying with AAMA 2605 and containing not less than 50 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

2.11 STAINLESS-STEEL FINISHES

A. Remove tool and die marks and stretch lines, or blend into finish.

B. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

C. 180-Grit Polished Finish: Oil-ground, uniform, directionally textured finish.

D. 320-Grit Polished Finish: Oil-ground, uniform, fine, directionally textured finish.

E. Polished and Buffed Finish: Oil-ground, 180-grit finish followed by buffing.

F. Directional Satin Finish: No. 4.

G. Dull Satin Finish: No. 6.

H. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.

B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches of post.

3.4 ANCHORING POSTS

A. Use metal sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

C. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material or attached to post with set screws if powder coated].

D. Leave anchorage joint exposed with anchoring material flush with adjacent surface.

E. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

1. For aluminum pipe railings, attach posts using fittings designed and engineered for this purpose.
2. For stainless-steel pipe railings, weld flanges to post and bolt to supporting surfaces.
3. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.

F. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.5 ATTACHING RAILINGS

A. Anchor railing ends at walls with round flanges anchored to wall construction and welded to railing ends or connected to railing ends using nonwelded connections where allowed.

B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends or connected to railing ends using nonwelded connections where allowed.

C. Attach railings to wall with wall brackets, except where end flanges are used. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

D. Secure wall brackets and railing end flanges to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.
3. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.
4. For steel-framed partitions, use hanger or lag bolts set into fire-retardant-treated wood backing between studs. Coordinate with stud installation to locate backing members.
5. For steel-framed partitions, use self-tapping screws fastened to steel framing or to concealed steel reinforcements.
6. For steel-framed partitions, use toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

3.6 ADJUSTING AND CLEANING

A. Clean aluminum and stainless steel by washing thoroughly with clean water and soap and rinsing with clean water.

B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

C. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099600 "High-Performance Coatings."

D. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A 780/A 780M.

3.7 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 324000

SECTION 328400 - PLANTING IRRIGATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Piping.
2. Encasement for piping.
3. Manual valves.
4. Pressure-reducing valves.
5. Automatic control valves.
6. Transition fittings.
7. Dielectric fittings.
8. Miscellaneous piping specialties.
9. Sprinklers.
10. Quick couplers.
11. Drip irrigation specialties.
12. Controllers.
13. Boxes for automatic control valves.

1.3 DEFINITIONS

A. Circuit Piping: Downstream from control valves to sprinklers, specialties, and drain valves. Piping is under pressure during flow.

B. Main Piping: Downstream from point of connection to water distribution piping to, and including, control valves. Piping is under water-distribution-system pressure.

C. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.4 PERFORMANCE REQUIREMENTS

A. Irrigation zone control shall be automatic operation with controller and automatic control valves.

B. Location of Sprinklers and Specialties: Design location is approximate. Make minor adjustments necessary to avoid plantings and obstructions such as signs and light standards. Maintain 100 percent irrigation coverage of areas indicated.

C. Minimum Working Pressures: The following are minimum pressure requirements for piping, valves, and specialties unless otherwise indicated:

1. Irrigation Main Piping: 200 psig.
2. Circuit Piping: 150 psig.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Wiring Diagrams: For power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Irrigation systems, drawn to scale, on which components are shown and coordinated with each other, using input from Installers of the items involved. Also include adjustments necessary to avoid plantings and obstructions such as signs and light standards.

B. Qualification Data: For qualified Installer.

C. Zoning Chart: Show each irrigation zone and its control valve.

D. Controller Timing Schedule: Indicate timing settings for each automatic controller zone.

E. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sprinklers, controllers, and automatic control valves to include in operation and maintenance manuals.

1.8 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. Rotor and Rotator Sprinklers: Equal to 5 percent of amount installed for each type and size indicated, but no fewer than 5 units.
2. Spray Sprinklers: Equal to 5 percent of amount installed for each type and size indicated, but no fewer than 5 units.
3. Bubblers: Equal to 5 percent of amount installed for each type indicated, but no fewer than 5 units.
4. Drip-Tube System Tubing: Equal to 5 percent of total length installed for each type and size indicated, but not less than 100 feet of each type.

1.9 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.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.11 PROJECT CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of water service.
2. Do not proceed with interruption of water service without Construction Manager's written permission.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Comply with requirements in the piping schedule for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

B. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end.
3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.

C. PVC Pipe: ASTM D 1785, PVC 1120 compound, Schedules 40 and 80.

1. PVC Socket Fittings: ASTM D 2466, Schedules 40 and 80.
2. PVC Threaded Fittings: ASTM D 2464, Schedule 80.
3. PVC Socket Unions: Construction similar to MSS SP-107, except both headpiece and tailpiece shall be PVC with socket ends.

D. PVC Pipe, Pressure Rated: ASTM D 2241, PVC 1120 compound, SDR 21 and SDR 26.

1. PVC Socket Fittings: ASTM D 2467, Schedule 80.
2. PVC Socket Unions: Construction similar to MSS SP-107, except both headpiece and tailpiece shall be PVC with socket or threaded ends.

2.2 PIPING JOINING MATERIALS

A. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.3 MANUAL VALVES

A. Brass Ball Valves:
1. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Two piece.
e. Body Material: Forged brass.
f. Ends: Threaded or solder joint if indicated.

g. Seats: PTFE or TFE.
h. Stem: Brass.
i. Ball: Chrome-plated brass.
j. Port: Full or regular, but not reduced.

B. Bronze Ball Valves:
1. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig (1035 kPa).
c. CWP Rating: 600 psig (4140 kPa).
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded or solder joint if indicated.
g. Seats: PTFE or TFE.
h. Stem: Bronze.
i. Ball: Chrome-plated brass.
j. Port: Full or regular, but not reduced.

C. Plastic Ball Valves:
1. Description:

a. Standard: MSS SP-122.
b. Pressure Rating: 150 psig.
c. Body Material: PVC.
d. Type: Union.
e. End Connections: Socket or threaded.
f. Port: Full.

D. Bronze Gate Valves:
1. Description:

a. Standard: MSS SP-80, Type 2.
b. Class: 125.
c. CWP Rating: 200 psig (1380 kPa).
d. Body Material: ASTM B 62 bronze with integral seat and screw-in bonnet.
e. Ends: Threaded or solder joint.
f. Stem: Bronze, non-rising.
g. Disc: Solid wedge; bronze.
h. Packing: Asbestos free.
i. Handwheel: Malleable iron, bronze, or aluminum.

2.4 AUTOMATIC CONTROL VALVES

A. Plastic, Automatic Control Valves:
1. Description: Molded-plastic body, normally closed, diaphragm type with manual-flow adjustment, and operated by 24-V ac solenoid.

2.5 TRANSITION FITTINGS

A. General Requirements: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

B. Transition Couplings:
1. Description: AWWA C219, metal sleeve-type coupling for underground pressure piping.

C. Plastic-to-Metal Transition Fittings:

1. Description: PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-socket or threaded end.

D. Plastic-to-Metal Transition Unions:
1. Description: MSS SP-107, PVC four-part union. Include one brass or stainless-steel threaded end, one solvent-cement-joint or threaded plastic end, rubber O-ring, and union nut.

2.6 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

B. Dielectric Unions:
1. Description: Factory-fabricated union, NPS 2 (DN 50) and smaller.

a. Pressure Rating: 150 psig minimum at 180 deg F.
b. End Connections: Solder-joint copper alloy and threaded ferrous; threaded ferrous.

C. Dielectric Flanges:
1. Description: Factory-fabricated, bolted, companion-flange assembly, NPS 2-1/2 to NPS 4 (DN 65 to DN 100) and larger.

a. Pressure Rating: 150 psig minimum.
b. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric Couplings:
1. Description: Galvanized-steel coupling.

a. Pressure Rating: 300 psig (2070 kPa) at 225 deg F (107 deg C).
b. End Connections: Female threaded.
c. Lining: Inert and noncorrosive, thermoplastic lining.

E. Dielectric Nipples:
1. Description: Electroplated steel nipple complying with ASTM F 1545.

a. Pressure Rating: 300 psig at 225 deg F.
b. End Connections: Male threaded or grooved.
c. Lining: Inert and noncorrosive, propylene.

2.7 MISCELLANEOUS PIPING SPECIALTIES

A. Water Hammer Arresters: ASSE 1010 or PDI WH 201, with bellows or piston-type pressurized cushioning chamber and in sizes complying with PDI WH 201, Sizes A to F.

B. Pressure Gages: ASME B40.1. Include 4-1/2-inch- diameter dial, dial range of two times system operating pressure, and bottom outlet.

2.8 SPRINKLERS

A. General Requirements: Designed for uniform coverage over entire spray area indicated at available water pressure.

B. Plastic, Pop-up, Gear-Drive Rotary Sprinklers:
1. Description:

a. Body Material: ABS.
b. Nozzle: ABS.
c. Retraction Spring: Stainless steel.
d. Internal Parts: Corrosion resistant.

2. Capacities and Characteristics:
a. As indicated on plans.

C. Plastic, Pop-up Spray Sprinklers:
1. Description:

a. Body Material: ABS.
b. Nozzle: ABS.
c. Retraction Spring: Stainless steel.
d. Internal Parts: Corrosion resistant.
e. Pattern: Fixed, with flow adjustment.

2. Capacities and Characteristics:
a. As indicated on plans.

D. Plastic Shrub Sprinklers:
1. Description:

a. Body Material: ABS or other plastic.
b. Pattern: Fixed, with flow adjustment.

2. Capacities and Characteristics:
a. As indicated on plans.

2.9 QUICK COUPLERS

A. Description: Factory-fabricated, bronze or brass, two-piece assembly. Include coupler water-seal valve; removable upper body with spring-loaded or weighted, rubber-covered cap; hose swivel with ASME B1.20.7, 3/4-11.5NH threads for garden hose on outlet; and operating key.

1. Locking-Top Option: Vandal-resistant locking feature. Include one matching key(s).

2. Provide ACME threads for recycled water systems.

2.10 DRIP IRRIGATION SPECIALTIES

A. Drip Tubes with Direct-Attached Emitters:

1. Tubing: Flexible PE or PVC with plugged end.
2. Emitters: Devices to deliver water at approximately 20 psig (138 kPa).

a. Body Material: PE or vinyl, with flow control.
b. Mounting: Inserted into tubing at set intervals.

3. Capacities and Characteristics:
a. As indicated on plans.

B. Application Pressure Regulators: Brass or plastic housing, NPS 3/4 (DN 20), with corrosion-resistant internal parts; capable of controlling outlet pressure to approximately 20 psig (138 kPa).

C. Filter Units: Brass or plastic housing, with corrosion-resistant internal parts; of size and capacity required for devices downstream from unit.

D. Air Relief Valves: Brass or plastic housing, with corrosion-resistant internal parts.

E. Vacuum Relief Valves: Brass or plastic housing, with corrosion-resistant internal parts.

2.11 CONTROLLERS

A. Description:

1. Controller Stations for Automatic Control Valves: Each station is variable from approximately 5 to 60 minutes. Include switch for manual or automatic operation of each station.
2. Exterior Control Enclosures: NEMA 250, Type 4, weatherproof, with locking cover and two matching keys; include provision for grounding.

    a. Body Material: Stainless-steel sheet metal.
    b. Mounting: Freestanding type for concrete base.

3. Control Transformer: 24-V secondary, with primary fuse.
4. Timing Device: Adjustable, 24-hour, 14-day clock, with automatic operations to skip operation any day in timer period, to operate every other day, or to operate two or more times daily.

    a. Manual or Semiautomatic Operation: Allows this mode without disturbing preset automatic operation.
    b. Nickel-Cadmium Battery and Trickle Charger: Automatically powers timing device during power outages.
    c. Surge Protection: Metal-oxide-varistor type on each station and primary power.

5. Rain Sensor: Adjustable from one to seven days, to shut off water flow during rain.
6. Wiring: UL 493, Type UF multiconductor, with solid-copper conductors; insulated cable; suitable for direct burial.

    a. Feeder-Circuit Cables: No. 12 AWG minimum, between building and controllers.
    b. Low-Voltage, Branch-Circuit Cables: No. 14 AWG minimum, between controllers and automatic control valves; color-coded different from feeder-circuit-cable jacket color; with jackets of different colors for multiple-cable installation in same trench.
    c. Splicing Materials: Manufacturer's packaged kit consisting of insulating, spring-type connector or crimped joint and epoxy resin moisture seal; suitable for direct burial.

7. Concrete Base: Reinforced precast concrete not less than 36 by 24 by 4 inches thick, and 6 inches greater in each direction than overall dimensions of controller. Include opening for wiring.

2.12 BOXES FOR AUTOMATIC CONTROL VALVES

A. Plastic Boxes:
1. Description: Box and cover, with open bottom and openings for piping; designed for installing flush with grade.

    a. Size: As required for valves and service.
    b. Shape: As indicated on plan.

        1) Lettering: "VALVE BOX", “IRRIGATION”, Etc.

B. Polymer-Concrete Boxes:
1. Description: Box and cover, with open bottom and openings for piping; designed for installing flush with grade.

a. Size: As required for valves and service.
b. Shape: As indicated on plan.

1) Lettering: "VALVE BOX", “IRRIGATION”, Etc.

C. Drainage Backfill: Cleaned gravel or crushed stone, graded from 3/4 inch minimum to 3 inches maximum.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

B. Install warning tape directly above pressure piping, 12 inches below finished grades, except 6 inches subgrade under pavement and slabs.

C. Provide minimum cover over top of underground piping according to the following:

1. Irrigation Main Piping: Minimum depth of 18 inches below finished grade.
2. Lateral Piping: 12 inches.
3. Sleeves: 24 inches below pedestrian paving and 36 inches below vehicular paving.

3.2 PREPARATION

A. Set stakes to identify locations of proposed irrigation system. Obtain Architect's approval before excavation.

3.3 PIPING INSTALLATION

A. Location and Arrangement: Drawings indicate location and arrangement of piping systems. Install piping as indicated unless deviations are approved on Coordination Drawings.

B. Install piping free of sags and bends.

C. Install groups of pipes parallel to each other, spaced to permit valve servicing.

D. Install fittings for changes in direction and branch connections.

E. Install unions adjacent to valves and to final connections to other components with NPS 2 (DN 50) or smaller pipe connection.

F. Install flanges adjacent to valves and to final connections to other components with NPS 2-1/2 (DN 65) or larger pipe connection.

G. Lay piping on solid subbase, uniformly sloped without humps or depressions.

H. Install PVC piping in dry weather when temperature is above 40 deg F (5 deg C). Allow joints to cure at least 24 hours at temperatures above 40 deg F (5 deg C) before testing.

I. Install water regulators with shutoff valve and strainer on inlet and pressure gage on outlet. Install shutoff valve on outlet. Install aboveground or in control-valve boxes.

J. Water Hammer Arresters: Install between connection to building main and circuit valves aboveground or in control-valve boxes.

K. Install piping in sleeves under parking lots, roadways, and sidewalks.

L. Install sleeves made of Schedule 40 PVC pipe and socket fittings, and solvent-cemented joints.

M. Install transition fittings for plastic-to-metal pipe connections according to the following:

1. Underground Piping:

a. NPS 1-1/2 (DN 40) and Smaller: Plastic-to-metal transition fittings.
b. NPS 2 (DN 50) and Larger: AWWA transition couplings.

2. Aboveground Piping:

a. NPS 2 (DN 50) and Smaller: Plastic-to-metal transition fittings.
b. NPS 2 (DN 50) and Larger: Use dielectric flange kits with one plastic flange.

N. Install dielectric fittings for dissimilar-metal pipe connections according to the following:

1. Underground Piping:

a. NPS 2 (DN 50) and Smaller: Dielectric coupling or dielectric nipple.
b. NPS 2-1/2 (DN 65) and Larger: Prohibited except in control-valve box.

2. Aboveground Piping:

a. NPS 2 (DN 50) and Smaller: Dielectric union.
b. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Dielectric flange.
c. NPS 5 (DN 125) and Larger: Dielectric flange kit.

3. Piping in Control-Valve Boxes:

a. NPS 2 (DN 50) and Smaller: Dielectric union.
b. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Dielectric flange.
c. NPS 5 (DN 125) and Larger: Dielectric flange kit.

3.4 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. 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.

D. Flanged Joints: Select rubber gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

E. Copper-Tubing Brazed Joints: Construct joints according to CDA's "Copper Tube Handbook," using copper-phosphorus brazing filler metal.

F. Copper-Tubing Soldered Joints: Apply ASTM B 813 water-flushable flux to tube end unless otherwise indicated. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy (0.20 percent maximum lead content) complying with ASTM B 32.

G. PVC Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. PVC Pressure Piping: Join schedule number, ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
3. PVC Nonpressure Piping: Join according to ASTM D 2855.

3.5 VALVE INSTALLATION

A. Underground Curb Valves: Install in curb-valve casings with tops flush with grade.

B. Underground Iron Gate Valves, Resilient Seat: Comply with AWWA C600 and AWWA M44. Install in valve casing with top flush with grade.

1. Install valves and PVC pipe with restrained, gasketed joints.

C. Aboveground Valves: Install as components of connected piping system.

D. Pressure-Reducing Valves: Install in boxes for automatic control valves or aboveground between shutoff valves.

E. Throttling Valves: Install in underground piping in boxes for automatic control valves.

3.6 SPRINKLER INSTALLATION

A. Install sprinklers after hydrostatic test is completed.

B. Install sprinklers at manufacturer's recommended heights.

C. Locate part-circle sprinklers to maintain a minimum distance of 4 inches from walls and 2 inches from other boundaries unless otherwise indicated.

3.7 DRIP IRRIGATION SPECIALTY INSTALLATION

A. Install drip tubes with direct-attached emitters 4” below ground.

B. Install application pressure regulators and filter units in piping near device being protected, and in control-valve boxes.

C. Install air relief valves and vacuum relief valves in piping, and in control-valve boxes.

3.8 AUTOMATIC IRRIGATION-CONTROL SYSTEM INSTALLATION

A. Equipment Mounting: Install controller pedestal on **concrete bases**.

1. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.

B. Equipment Mounting: Install exterior freestanding controllers on precast concrete bases.

1. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.

C. Install control cable in same trench as irrigation piping and at least 2 inches below or beside piping. Provide conductors of size not smaller than recommended by controller manufacturer. Install cable in separate sleeve under paved areas.

3.9 CONNECTIONS

A. Comply with requirements for piping specified in Section 221113 "Facility Water Distribution Piping" for water supply from exterior water service piping, water meters, protective enclosures, and backflow preventers. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment, valves, and devices to allow service and maintenance.

C. Connect wiring between controllers and automatic control valves.

3.10 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

B. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplates and signs on each automatic controller.

1. Text: In addition to identifying unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

C. Warning Tapes: Arrange for installation of continuous, underground, detectable warning tapes over underground piping during backfilling of trenches. See Section 312000 "Earth Moving" for warning tapes.

3.11 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, operate controllers and automatic control valves to confirm proper system operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Any irrigation product will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.12 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify that controllers are installed and connected according to the Contract Documents.
3. Verify that electrical wiring installation complies with manufacturer's submittal.

3.13 ADJUSTING

A. Adjust settings of controllers.

B. Adjust automatic control valves to provide flow rate at rated operating pressure required for each sprinkler circuit.

C. Adjust sprinklers and devices, except those intended to be mounted aboveground, so they will be flush with finish grade.

3.14 CLEANING

A. Flush dirt and debris from piping before installing sprinklers and other devices.

3.15 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain automatic control valves and controllers.

END OF SECTION 328400

SECTION 329115 - SOIL PREPARATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes planting soils specified according to performance requirements of the mixes.

B. Related Requirements:
1. Section 311000 "Site Clearing" for topsoil stripping and stockpiling.
2. Section 321443 "Porous Unit Paving" for placing planting-soil fill in porous paving.
3. Section 329200 "Turf and Grasses" for placing planting soil for turf and grasses.
4. Section 329300 "Plants" for placing planting soil for plantings.
5. Section 329600 "Transplanting" for placing planting soil in tree planting pits.
6. Section 329700 "Vegetated Roof Assemblies" for growing media (soil).

1.3 DEFINITIONS

A. AAPFCO: Association of American Plant Food Control Officials.

B. Backfill: The earth used to replace or the act of replacing earth in an excavation. This can be amended or unamended soil as indicated.

C. CEC: Cation exchange capacity.

D. Compost: The product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth.

E. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.

F. Imported Soil: Soil that is transported to Project site for use.

G. Layered Soil Assembly: A designed series of planting soils, layered on each other that together produce an environment for plant growth.

H. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.

I. NAPT: North American Proficiency Testing Program. An SSSA program to assist soil-, plant-, and water-testing laboratories through interlaboratory sample exchanges and statistical evaluation of analytical data.

J. Organic Matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called "humus" or "soil organic matter."

K. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

L. RCRA Metals: Hazardous metals identified by the EPA under the Resource Conservation and Recovery Act.

M. SSSA: Soil Science Society of America.

N. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

O. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

P. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil"; but in disturbed areas such as urban environments, the surface soil can be subsoil.

Q. USCC: U.S. Composting Council.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site .

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include recommendations for application and use.
2. Include test data substantiating that products comply with requirements.
3. Include sieve analyses for aggregate materials.
4. Material Certificates: For each type of imported soil, soil amendment and fertilizer before delivery to the site, according to the following:

    a. Manufacturer's qualified testing agency's certified analysis of standard products.
    b. Analysis of fertilizers, by a qualified testing agency, made according to AAPFCO methods for testing and labeling and according to AAPFCO's SUIP #25.
    c. Analysis of nonstandard materials, by a qualified testing agency, made according to SSSA methods, where applicable.

B. Sustainable Design Submittals:

C. Samples: For each bulk-supplied material, 1-quart volume of each in sealed containers labeled with content, source, and date obtained. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of composition, color, and texture.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For each testing agency.

B. Preconstruction Test Reports: For preconstruction soil analyses specified in "Preconstruction Testing" Article.

C. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed.

1. Laboratories: Subject to compliance with requirements, provide testing by one of the following:

a. Wallace Labs.

b. Soil and Plant Laboratory, Inc.

c. Waypoint Analytical

2. Multiple Laboratories: At Contractor's option, work may be divided among qualified testing laboratories specializing in physical testing, chemical testing, and fertility testing.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction soil analyses on existing, on-site soil and imported soil.

1. Notify Architect seven days in advance of the dates and times when laboratory samples will be taken.

B. Preconstruction Soil Analyses: For each unamended soil type, perform testing on soil samples and furnish soil analysis and a written report containing soil-amendment and fertilizer recommendations by a qualified testing agency performing the testing according to "Soil-Sampling Requirements" and "Testing Requirements" articles.

1. Have testing agency identify and label samples and test reports according to sample collection and labeling requirements.

1.9 SOIL-SAMPLING REQUIREMENTS

A. General: Extract soil samples according to requirements in this article.

B. Sample Collection and Labeling: Have samples taken and labeled Contractor in presence of Landscape Architect under the direction of the testing agency.

1. Number and Location of Samples: Minimum of eight representative soil samples for each soil to be used or amended for landscaping purposes.
2. Procedures and Depth of Samples: According to USDA-NRCS's "Field Book for Describing and Sampling Soils."
3. Division of Samples: Split each sample into two, equal parts. Send half to the testing agency and half to Owner for its records.
4. Labeling: Label each sample with the date, location keyed to a site plan or other location system, visible soil condition, and sampling depth.

1.10 TESTING REQUIREMENTS

A. General: Perform tests on soil samples according to requirements in this article.

B. Physical Testing:

1. Soil Texture: Soil-particle, size-distribution analysis by one of the following methods according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods":

    a. Sieving Method: Report sand-gradation percentages for very coarse, coarse, medium, fine, and very fine sand; and fragment-gradation (gravel) percentages for fine, medium, and coarse fragments; according to USDA sand and fragment sizes.
    b. Hydrometer Method: Report percentages of sand, silt, and clay.

2. Bulk Density: Analysis according to core method and clod method of SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
3. Total Porosity: Calculate using particle density and bulk density according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
4. Water Retention: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
5. Saturated Hydraulic Conductivity: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods"; at 85% compaction according to ASTM D 698 (Standard Proctor).

C. Chemical Testing:

1. CEC: Analysis by sodium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."
2. Clay Mineralogy: Analysis and estimated percentage of expandable clay minerals using CEC by ammonium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
3. Metals Hazardous to Human Health: Test for presence and quantities of RCRA metals including aluminum, arsenic, barium, copper, cadmium, chromium, cobalt, lead, lithium, and vanadium. If RCRA metals are present, include recommendations for corrective action.
4. Phytotoxicity: Test for plant-available concentrations of phytotoxic minerals including aluminum, arsenic, barium, cadmium, chlorides, chromium, cobalt, copper, lead, lithium, mercury, nickel, selenium, silver, sodium, strontium, tin, titanium, vanadium, and zinc.

D. Fertility Testing: Soil fertility analysis according to standard laboratory protocol, including the following:

1. Percentage of organic matter.
2. CEC, calcium percent of CEC, and magnesium percent of CEC.
3. Soil reaction (acidity/alkalinity pH value).
4. Buffered acidity or alkalinity.
5. Nitrogen ppm.
6. Phosphorous ppm.
7. Potassium ppm.
8. Manganese ppm.
9. Manganese-availability ppm.
10. Zinc ppm.
11. Zinc availability ppm.
12. Copper ppm.
13. Sodium ppm and sodium absorption ratio.
14. Soluble-salts ppm.
15. Presence and quantities of problem materials including salts and metals cited in the Standard protocol. If such problem materials are present, provide additional recommendations for corrective action.
16. Other deleterious materials, including their characteristics and content of each.

E. Organic-Matter Content: Analysis using loss-by-ignition method according to SSSA's "Methods of Soil Analysis - Part 3-Chemical Methods."

F. Recommendations: Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated to produce satisfactory planting soil suitable for healthy, viable plants indicated. Include, at a minimum, recommendations for nitrogen, phosphorous, and potassium fertilization, and for micronutrients.

1. Fertilizers and Soil Amendment Rates: State recommendations in weight per 1000 sq. ft. for 6-inch depth of soil.
2. Soil Reaction: State the recommended liming rates for raising pH or sulfur for lowering pH according to the buffered acidity or buffered alkalinity in weight per 1000 sq. ft. for 6-inch depth of soil and as backfill per cubic yard.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and compliance with state and Federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Do not move or handle materials when they are wet or frozen.
4. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

PART 2 - PRODUCTS

2.1 MATERIALS

2.2 PLANTING SOILS SPECIFIED ACCORDING TO PERFORMANCE REQUIREMENTS

A. Planting-Soil Type: Existing, on-site surface soil, with the duff layer, if any, retained and stockpiled on-site; modified to produce viable planting soil. Using preconstruction soil analyses and materials specified in other articles of this Section, amend existing, on-site surface soil to become planting soil complying with the following requirements:

1. Particle Size Distribution by USDA Textures: Classified as sandy loam according to USDA textures.

2. Percentage of Organic Matter: Minimum 3 percent by volume.
3. Soil Reaction: pH of 6 to 7.
4. CEC of Total Soil: Minimum 7 meq/100 mL at pH of 7.0.
5. Soluble-Salt Content: 5 to 10 dS/m measured by electrical conductivity.
6. RCRA Metals: Below maximum limits established by the EPA.
7. Phytotoxicity: Below phytotoxicity limits established by SSSA.

B. Planting-Soil Type: Imported, naturally formed soil from off-site sources and consisting of sandy loam soil according to USDA textures; and modified to produce viable planting soil. Amend imported soil with materials specified in other articles of this Section to become planting soil complying with the following requirements:

1. Sources: Take imported, unamended soil from sources that are naturally well-drained sites where topsoil occurs at least 4 inches deep, not from bogs, or marshes; and that do not contain undesirable organisms; disease-causing plant pathogens; or obnoxious weeds and invasive plants including, but not limited to, quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, and bromegrass.
2. Additional Properties of Imported Soil before Amending: Minimum of 3 percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration. Clean soil to be of the following:

a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand.
c. Large Materials: Stones 1 inch in any dimension.

3. Percentage of Organic Matter: Minimum 3 percent by volume.
4. Soil Reaction: pH of 6 to 7.
5. CEC of Total Soil: Minimum 7 meq/100 mL at pH of 7.
6. CEC of Clay Fraction: Maximum 15 meq/100 mL at pH of 7.
7. Soluble-Salt Content: 5 to 10 dS/m measured by electrical conductivity.
8. Bulk Density: 1.0 g/cu. cm to 1.4 g/cu. cm at 85% compaction.
9. Total Porosity: Minimum 50 percent at 85% compaction.
10. Macro Porosity: Minimum 10 percent at 85% compaction.
11. RCRA Metals: Below maximum limits established by the EPA.
12. Phytotoxicity: Below phytotoxicity limits established by SSSA.

2.3 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:

1. Class: T, with a minimum of 99 percent passing through a No. 8 sieve and a minimum of 75 percent passing through a No. 60 sieve.
2. Class: O, with a minimum of 95 percent passing through No. 8 sieve and a minimum of 55 percent passing through a No. 60 sieve.
3. Form: Provide lime in form of ground dolomitic limestone, calcitic limestone, or mollusk shells.

B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent elemental sulfur, with a minimum of 99 percent passing through a No. 6 sieve and a maximum of 10 percent passing through a No. 40 sieve.

C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

D. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through a No. 50 sieve.

E. Sand: Clean, washed, natural or manufactured, free of toxic materials, and according to ASTM C 33/C 33M.

2.4 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter produced by composting feedstock, and bearing USCC's "Seal of Testing Assurance," and as follows:

1. Feedstock: Limited to green waste.
2. Reaction: pH of 5.5 to 8.
3. Soluble-Salt Concentration: Less than 4 dS/m.
4. Moisture Content: 35-55 percent by weight.
5. Organic-Matter Content: 50 to 60 percent of dry weight.
6. Particle Size: Minimum of 98 percent passing through a ½ inch sieve.

B. Wood Derivatives: Shredded and composted, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.

1. Partially Decomposed Wood Derivatives: In lieu of shredded and composted wood derivatives, mix shredded and partially decomposed wood derivatives with ammonium nitrate at a minimum rate of 0.15 lb/cu. ft. of loose sawdust or ground bark, or with ammonium sulfate at a minimum rate of 0.25 lb/cu. ft. of loose sawdust or ground bark.

2.5 FERTILIZERS

A. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

B. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: 1 lb/1000 sq. ft**.** of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

C. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

D. Chelated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.

PART 3 - EXECUTION

3.1 GENERAL

A. Place planting soil and fertilizers according to requirements in other Specification Sections.

B. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.

C. Proceed with placement only after unsatisfactory conditions have been corrected.

3.2 PREPARATION OF UNAMENDED, ON-SITE SOIL BEFORE AMENDING

A. Unacceptable Materials: Clean soil of concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.

3.3 PLACING AND MIXING PLANTING SOIL OVER EXPOSED SUBGRADE

A. General: Apply and mix unamended soil with amendments on-site to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Subgrade Preparation: Till subgrade to a minimum depth of 4 inches. Remove stones larger than 2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter that appear on the surface after soil preparation is complete and legally dispose of them off Owner's property.

C. Mixing: Spread unamended soil to total depth 6 inches, but not less than required to meet finish grades after mixing with amendments and natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.

1. Amendments: Apply soil amendments, and fertilizer, if required, evenly on surface, and thoroughly blend them with unamended soil to produce planting soil.

    a. Mix lime and sulfur with dry soil before mixing fertilizer.
    b. Mix fertilizer with planting soil no more than seven days before planting.

2. Lifts: Apply and mix unamended soil and amendments in lifts not exceeding 12 inches in loose depth for material compacted by compaction equipment, and not more than 6 inches in loose depth for material compacted by hand-operated tampers.

D. Compaction: Compact each blended lift of planting soil to 75-82 percent of maximum Standard Proctor density according to ASTM D 698 except where a different compaction value is indicated on Drawings.

E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections:

1. Compaction: Test planting-soil compaction after placing each lift and at completion using a densitometer or soil-compaction meter calibrated to a reference test value based on laboratory testing according to ASTM D 698. Space tests at no less than one for each 5000 square feet of in-place soil or part thereof.
2. Performance Testing: For each amended planting-soil type, demonstrating compliance with specified performance requirements. Perform testing according to "Soil-Sampling Requirements" and "Testing Requirements" articles.

C. Soil will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Label each sample and test report with the date, location keyed to a site plan or other location system, visible conditions when and where sample was taken, and sampling depth.

3.5 PROTECTION

A. Protection Zone: Identify protection zones according to Section 015639 "Temporary Tree and Plant Protection."

B. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Vehicle traffic.
4. Foot traffic.
5. Erection of sheds or structures.
6. Impoundment of water.
7. Excavation or other digging unless otherwise indicated.

C. If planting soil or subgrade is overcompacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the planting soil and contamination; restore the subgrade as directed by Architect and replace contaminated planting soil with new planting soil.

3.6 CLEANING

A. Protect areas adjacent to planting-soil preparation and placement areas from contamination. Keep adjacent paving and construction clean and work area in an orderly condition.

B. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.

END OF SECTION 329115

SECTION 329200 - TURF AND GRASSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Sodding.

B. Related Requirements:

1. Section 329300 "Plants" for trees, shrubs, ground covers, and other plants as well as border edgings and mow strips.

1.3 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

D. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329115 "Soil Preparation" and drawing designations for planting soils.

E. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For landscape Installer.

B. Product Certificates: For fertilizers, from manufacturer.

C. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of turf during a calendar year. Submit before expiration of required maintenance periods.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf establishment.

1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
2. Experience: Five years' experience in turf installation in addition to requirements in Section 014000 "Quality Requirements."
3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
4. Personnel Certifications: Installer's field supervisor shall have certification in all of the following categories from the Professional Landcare Network:

    a. Landscape Industry Certified Technician - Exterior.
    b. Landscape Industry Certified Lawncare Manager.
    c. Landscape Industry Certified Lawncare Technician.

5. Pesticide Applicator: State licensed, commercial.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.

B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" sections in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod within 24 hours of harvesting and in time for planting promptly. Protect sod from breakage and drying.

C. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 TURFGRASS SOD

A. Turfgrass Sod: Certified, complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture that is strongly rooted and capable of vigorous growth and development when planted.

B. Turfgrass Species: Southland Sod Farms Marathon 2 Dwarf Tall Fescue.

2.2 FERTILIZERS

A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

2.3 PESTICIDES

A. General: Pesticide, registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
3. Uniformly moisten excessively dry soil that is not workable or which is dusty.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.2 PREPARATION

A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.
2. Protect grade stakes set by others until directed to remove them.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 TURF AREA PREPARATION

A. General: Prepare planting area for soil placement and mix planting soil according to Section 329115 "Soil Preparation."

B. Placing Planting Soil: Place and mix planting soil in place over exposed subgrade.

1. Reduce elevation of planting soil to allow for soil thickness of sod.

C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

D. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 SODDING

A. Lay sod within 24 hours of harvesting unless a suitable preservation method is accepted by Architect prior to delivery time. Do not lay sod if dormant or if ground is frozen or muddy.

B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to soil or sod during installation. Tamp and roll lightly to ensure contact with soil, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.

1. Lay sod across slopes exceeding 1:3.
2. Anchor sod on slopes exceeding 1:6 with wood pegs spaced as recommended by sod manufacturer but not less than two anchors per sod strip to prevent slippage.

C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches (38 mm) below sod.

3.5 TURF MAINTENANCE

A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or

eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches (100 mm).

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
2. Water turf with fine spray at a minimum rate of 1 inch (25 mm) per week unless rainfall precipitation is adequate.

C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:

1. Mow bentgrass to a height of 1/2 inch or less.
2. Mow bermudagrass to a height of 1/2 to 1 inch.
3. Mow perennial ryegrass to a height of 1 to 2 inches.
4. Mow annual ryegrass to a height of 1-1/2 to 2 inches.
5. Mow turf-type tall fescue to a height of 2 to 3 inches.

D. Turf Post fertilization: Apply commercial fertilizer after initial mowing and when grass is dry.

1. Use fertilizer that provides actual nitrogen of at least 1 lb/1000 sq. ft**.** to turf area.

3.6 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Architect:

1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.
2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.
3. Satisfactory Plugged Turf: At end of maintenance period, the required number of plugs has been established as well-rooted, viable patches of grass, and areas between plugs are free of weeds and other undesirable vegetation.
4. Satisfactory Sprigged Turf: At end of maintenance period, the required number of sprigs has been established as well-rooted, viable plants, and areas between sprigs are free of weeds and other undesirable vegetation.

B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

3.7 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents according to requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with

Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.8 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.

C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

D. Remove nondegradable erosion-control measures after grass establishment period.

3.9 MAINTENANCE SERVICE

A. Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Turf Maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable turf is established, but for not less than the following periods:

a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.

2. Sodded Turf: 90 days from the last day of the maintenance period or final acceptance of the contract work, whichever is later.

END OF SECTION 329200

SECTION 329300 - PLANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Plants.
2. Tree stabilization.
3. Landscape edgings.
4. Tree grates.

B. Related Requirements:

1. Section 015639 "Temporary Tree and Plant Protection" for protecting, trimming, pruning, repairing, and replacing existing trees to remain that interfere with, or are affected by, execution of the Work.

1.3 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.

C. Finish Grade: Elevation of finished surface of planting soil.

D. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant. Some sources classify herbicides separately from pesticides.

E. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

F. Planting Area: Areas to be planted.

G. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329113 "Soil Preparation" for drawing designations for planting soils.

H. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.

I. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

J. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.

K. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 COORDINATION

A. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.

1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
2. Plant Photographs: Include color photographs in digital 3 inch by 5 inch print format of each required species and size of plant material as it will be furnished to Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 4 plants are required, include a minimum of three photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.

B. Samples for Verification: For each of the following:
1. Organic Compost Mulch: 1 pint volume of each organic mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
2. Root-Ball-Stabilization Device: Per Plans.
3. Slow-Release, Tree-Watering Device: One unit of each size required.
4. Edging Materials and Accessories: Manufacturer's standard size, to verify color selected.
5. Tree Grates and Accessories: Manufacturer's standard size delivered to site for review, to verify design and color selected.
6. Root Barrier: Per plans.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.

B. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:

1. Manufacturer's certified analysis of standard products.
2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.

C. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

1.8 CLOSEOUT SUBMITTALS

A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before expiration of required maintenance periods.

1.9 QUALITY ASSURANCE

A. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

1. Selection of plants purchased under allowances is made by Landscape Architect, who tags plants at their place of growth before they are prepared for transplanting.

B. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.

1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container-grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.
2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

C. Plant Material Observation: Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Architect may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

1. Notify Architect of sources of planting materials seven days in advance of delivery to site.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

C. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

D. Handle planting stock by root ball.

E. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

F. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

1. Heel-in bare-root stock. Soak roots that are in less than moist condition in water for two hours. Reject plants with dry roots.
2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
3. Do not remove container-grown stock from containers before time of planting.
4. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly wet condition.

1.11 FIELD CONDITIONS

A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

1.12 WARRANTY

A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner.
b. Structural failures including plantings falling or blowing over.
c. Faulty performance of tree stabilization.
d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Periods: From date of Substantial Completion.

a. Trees larger than 24” box: 12 months.

b. Shrubs, Vines, and Ornamental Grasses: 3 months.

3. Include the following remedial actions as a minimum:

a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
c. A limit of one replacement of each plant is required except for losses or replacements due to failure to comply with requirements.
d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots are unacceptable.
2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.

C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

D. Labeling: Label at least one plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant.

E. If formal arrangements or consecutive order of plants is indicated on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.

2.2 FERTILIZERS

A. Planting Tablets: Tightly compressed chip-type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.

1. Size: 21-gram tablets.
2. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

2.3 MULCHES

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:

1. Type: per plan.
2. Size Range: 3 inches maximum, ½ inch minimum.
3. Color: Natural.

B. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through a 1-inch (25-mm) sieve; soluble-salt content of 2 to 5 dS/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 50-60 percent of dry weight.

2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.

2.4 WEED-CONTROL BARRIERS

A. Nonwoven Geotextile Filter Fabric: Polypropylene or polyester fabric, 3 oz./sq. yd. minimum, composed of fibers formed into a stable network so that fibers retain their relative position. Fabric shall be inert to biological degradation and resist naturally encountered chemicals, alkalis, and acids.

B. Composite Fabric: Woven, needle-punched polypropylene substrate bonded to a nonwoven polypropylene fabric, 4.8 oz./sq. yd.

2.5 PESTICIDES

A. General: Pesticide registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

2.6 TREE-STABILIZATION MATERIALS

A. Trunk-Stabilization Materials:

1. Upright and Guy Stakes: Rough-sawn, sound, new softwood with specified wood pressure-preservative treatment, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal by length indicated, pointed at one end.
2. Flexible Ties: Wide rubber or elastic bands or straps of length required to reach stakes or turnbuckles.
3. Guys and Tie Wires: ASTM A 641/A 641M, Class 1, galvanized-steel wire, two-strand, twisted, 0.106 inch in diameter.

2.7 LANDSCAPE EDGINGS

A. Steel Edging: Standard commercial-steel edging, fabricated in sections of standard lengths, with loops stamped from or welded to face of sections to receive stakes.
1. Edging Size: 1/4 inch thick by 5 inches deep.
2. Stakes: secure per plans
3. Accessories: Standard tapered ends, corners, and splicers.
4. Finish: natural.

2.8 TREE GRATES

A. Tree Grates: Manufacturer's custom designed tree grates and frame.

1. Iron Age Designs: Custom 72” diameter tree grate and frame.
2. Grates: Class 35 (Class 250) or better, gray-iron castings.
3. Frames: Class 35 (Class 250) or better, gray-iron castings of shape, pattern, and size indicated.

B. Shape and Size: 72” diameter.

C. Finish: As Fabricated.

2.9 MISCELLANEOUS PRODUCTS

A. Wood Pressure-Preservative Treatment: AWPA U1, Use Category UC4a; acceptable to authorities having jurisdiction, and containing no arsenic or chromium.

B. Root Barrier: Black, molded, modular panels 24 inches high (deep), 85 mils thick, and with vertical root deflecting ribs protruding 3/4 inch out from panel surface; manufactured with minimum 50 percent recycled polyethylene plastic with UV inhibitors.

1. DeepRoot Green Infrastructure, LLC.

2. Villa Landscape Producs

C. Burlap: Non-synthetic, biodegradable.

D. Planter Filter Fabric: nonwoven geotextile manufactured for separation applications and made of polypropylene, polyolefin, or polyester fibers or combination of them.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive plants, with Installer present, for compliance with requirements and conditions affecting installation and performance of the Work.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.
3. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
4. Uniformly moisten excessively dry soil that is not workable or which is dusty.

B. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Architect's acceptance of layout before excavating or planting. Make minor adjustments as required.

D. Lay out plants at locations directed by Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.

3.3 PLANTING AREA ESTABLISHMENT

A. General: Prepare planting area for soil placement and mix planting soil according to Section 329115 "Soil Preparation."

B. Placing Planting Soil: Blend planting soil in place.

C. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches: Excavate circular planting pits.

1. Excavate planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are unacceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
2. Excavate approximately two times as wide as ball diameter for container-grown stock.
3. Excavate at least 12 inches (300 mm) wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
4. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
5. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
6. Maintain angles of repose of adjacent materials to ensure stability. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
7. Maintain supervision of excavations during working hours.
8. Keep excavations covered or otherwise protected overnight, after working hours, when unattended by Installer's personnel.
9. If drain tile is indicated on Drawings or required under planting areas, excavate to top of porous backfill over tile.

B. Backfill Soil: Subsoil and topsoil removed from excavations may, when amended, be used as backfill soil unless otherwise indicated.

C. Obstructions: Notify Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.

1. Hardpan Layer: Drill 6-inch- diameter holes, 24 inches apart, into free-draining strata or to a depth of 10 feet, whichever is less, and backfill with free-draining material.

D. Drainage: Notify Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.

E. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

3.5 TREE, SHRUB, AND VINE PLANTING

A. Inspection: At time of planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.

B. Roots: Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.

C. Container-Grown Stock: Set each plant plumb and in center of planting pit or trench with root flare 2 inches above adjacent finish grades.

1. Backfill: Planting soil.
2. Carefully remove root ball from container without damaging root ball or plant.
3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
4. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.

    a. Quantity: Per manufacturer's recommendations.

5. Continue backfilling process. Water again after placing and tamping final layer of soil.

D. Slopes: When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.6 TREE, SHRUB, AND VINE PRUNING

A. Remove only dead, dying, or broken branches. Do not prune for shape.

B. Prune, thin, and shape trees, shrubs, and vines as directed by Architect.

C. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.

D. Do not apply pruning paint to wounds.

3.7 TREE STABILIZATION

A. Trunk Stabilization by Upright Staking and Tying: Install trunk stabilization as follows unless otherwise indicated:

1. Upright Staking and Tying: Stake trees of 2- through 5-inch caliper. Stake trees of less than 2-inch caliper only as required to prevent wind tip out. Use a minimum of two stakes of length required to penetrate at least 18 inches below bottom of backfilled excavation and to extend to the dimension indicated on Drawings above grade. Set vertical stakes and space to avoid penetrating root balls or root masses.
2. Upright Staking and Tying: Stake trees with two stakes for trees up to 12 feet high and 2-1/2 inches or less in caliper; three stakes for trees less than 14 feet high and up to 4 inches in caliper. Space stakes equally around trees.
3. Support trees with bands of flexible ties at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.

4. Support trees with two strands of tie wire, connected to the brass grommets of tree-tie webbing at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.

B. Trunk Stabilization by Staking and Guying: Install trunk stabilization as follows unless otherwise indicated on Drawings. Stake and guy trees more than 14 feet in height and more than 3 inches in caliper unless otherwise indicated.

1. Site-Fabricated, Staking-and-Guying Method: Install no fewer than three guys spaced equally around tree.
   a. Securely attach guys to galvanized anchor eye. Anchor eye screw to be anchored to inside of wall minimum 4" depth. 1/2" minimum rod size. Install 12” from top of planter wall typ. Adjust spacing to avoid penetrating root balls or root masses. Provide turnbuckle for each guy wire and tighten securely.

3.8 ROOT-BARRIER INSTALLATION

A. Install root barrier where trees are planted within 5 feet of paving or other hardscape elements, such as walls, curbs, and walkways, unless otherwise indicated on Drawings.

B. Align root barrier vertically, and run it linearly along and adjacent to the paving or other hardscape elements to be protected from invasive roots.

C. Install root barrier continuously for a distance of 10 feet in each direction from the tree trunk, for a total distance of 20 feet per tree. If trees are spaced closer, use a single continuous piece of root barrier.

1. Position top of root according to manufacturer's written recommendations.
2. Overlap root barrier a minimum of 12 inches (300 mm) at joints.
3. Do not distort or bend root barrier during construction activities.
4. Do not install root barrier surrounding the root ball of tree.

3.9 PLACING SOIL IN PLANTERS

A. Place a layer of drainage gravel at least 4 inches thick in bottom of planter. Cover bottom with filter fabric and wrap filter fabric 6 inches up on all sides. Duct tape along the entire top edge of the filter fabric, to secure the filter fabric against the sides during the soil-filling process.

B. Fill planter with planting soil. Place soil in lightly compacted layers to an elevation of 1-1/2 inches below top of planter, allowing natural settlement.

3.10 GROUND COVER AND PLANT PLANTING

A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated on Drawings in even rows with triangular spacing.

B. Use planting soil for backfill.

C. Dig holes large enough to allow spreading of roots.

D. For rooted cutting plants supplied in flats, plant each in a manner that minimally disturbs the root system but to a depth not less than two nodes.

E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.11 PLANTING AREA MULCHING

A. Install weed-control barriers before mulching according to manufacturer's written instructions. Completely cover area to be mulched, overlapping edges a minimum of 12 inches and secure seams with galvanized pins.

B. Mulch backfilled surfaces of planting areas and other areas indicated on plans.

3.12 EDGING INSTALLATION

A. Steel Edging: Install steel edging where indicated according to manufacturer's written instructions. Anchor with steel stakes spaced approximately 30 inches apart, driven below top elevation of edging.

B. Mow-Strip Installation:

1. Excavate for concrete mow strip as indicated on plans
2. Compact subgrade uniformly beneath mow strip.
3. Apply nonselective, pre-emergent herbicide that inhibits growth of grass and weeds.
4. Install concrete, delineating the edge of mow strip.

3.13 TREE GRATE INSTALLATION

A. Tree Grates: Install according to manufacturer's written instructions. Set grate segments flush with adjoining surfaces. Shim from supporting substrate with soil-resistant plastic. Maintain a 3-inch- minimum growth radius around base of tree; break away portions of casting, if necessary, according to manufacturer's written instructions.

3.14 PLANT MAINTENANCE

A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.

B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices when possible to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.15 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Pre-Emergent Herbicides (Selective and Nonselective): Apply to tree, shrub, and ground-cover areas according to manufacturer's written recommendations. Do not apply to seeded areas.

C. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.16 REPAIR AND REPLACEMENT

A. General: Repair or replace existing or new trees and other plants that are damaged by construction operations, in a manner approved by Architect.

1. Submit details of proposed pruning and repairs.
2. Perform repairs of damaged trunks, branches, and roots within 24 hours, if approved.
3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.

B. Remove and replace trees that are more than 25 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.

1. Provide new trees of same size as those being replaced.

3.17 CLEANING AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

D. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

E. At time of Substantial Completion, verify that tree-watering devices are in good working order and leave them in place. Replace improperly functioning devices.

3.18 MAINTENANCE SERVICE

A. Maintenance Service: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:

1. Maintenance Period: three months from date of Substantial Completion.

END OF SECTION 329300

SECTION 309300.21 – PLANTS – VEGETATED GREEN WALL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provision and installation of living wall planting modules, mounting rail, frameset, and irrigation systems as shown in Drawings.

1.2 RELATED WORK

B. Section 328400 “Planting Irrigation”

C. Section 329300 “Plants”

D. Section 033000 “Cast-in-Place Concrete”

E. Section 061000 “Rough Carpentry”

F. Section 055000 “Metal Fabrications”

1.3 SUBMITTALS

A. Product Data: Manufacturer's standard catalog data sheets, standard product details as required for installation and integration with other work.

B. Shop Drawings: For custom products only, showing critical sizes and dimensions for installation and integration with other work.

1.4 DELIVERY, STORAGE AND HANDLING

A. Inspect Tournesol VGM Modular living wall system packaging after delivery for signs of damage during transit. Confirm correct quantity and sizing of components prior to installation process.

B. Protect Tournesol VGM Modular living wall system packaging from damage during storage and handling.

C. Store living wall modules unassembled, in their original packaging. If rail is installed prior to final assembly, store framesets separately in their original packaging in clean, dry condition.

1.5 PROJECT CONDITIONS

A. Contractor to confirm that the wall behind the living wall system be water tight.

B. Engineer shall certify that the structure is capable of bearing the load of a modular living wall system.

C. Contractor to provide adequate structural support for planting rails.

D. Protect installed rails from damage by adjacent work.

E. Planted Tournesol VGM Modular Living wall modules should be placed on building only after substantial completion of project to protect plants.

PART 2- PRODUCTS

2.1 ACCEPTABLE PRODUCTS/MANUFACTURERS

A. Tournesol VGM Modular living wall planting modules, mounting frame and framesets, manufactured by Tournesol Siteworks LLC. 30955 San Antonio St., Hayward, CA 94544 Tel: (800) 542-2282 FAX (510) 471-6243

2.2 LIVING WALL MODULES

A. Materials – All module elements shall be constructed of 100% post-consumer recycled black polypropylene, and shall have a black synthetic non-woven soil retention bag.

B. Construction – Modules shall be constructed to allow maximum air penetration from the back and sides, ship unassembled for reduced freight cost, and snap together for quick assembly at the nursery. The units will have 16 openings across the front to support the planted soil retention bag, with supplemental retention bars to prevent soil erosion.

1. Finish: black factory finished.
2. Sizes: Modules to be 18.75”w x 22”h, either 6”thick (with 4” planting depth) or 10” thick (with 8” planting depth). Other depths may be fabricated as required.

2.3 LIVING WALL MODULE BRACKET

A. Materials – All module brackets shall be constructed of 304 stainless steel and shall be powder coated.

B. Construction – Brackets will be made as right and left side bracket, of sufficient strength to support a 250lb. load.

1. Finish: Black powder coated.
2. Sizes: To fit living wall modules. Brackets specifically manufactured for in right and leftsides for both VGM-10 and VGM-06 module depths.

2.4 LIVING WALL MODULE RAIL

A. Materials – All module rails shall be constructed of 304 stainless steel.

B. Construction – Rails shall have double slot module mounting holes, and wallmount holes along the rail.

1. Finish: Natural stainless steel.
2. Sizes: Rails to hold 1 (23-5/8”), 2 (47-1/4”) or 4 (94-1/2”) modules. Other sizes achieved by combining rails together.

2.5 LIVING WALL ACCESSORIES

A. Anchors – specification by engineer, depending upon the wall construction and local codes.

B. Irrigation – design by others. Typical installation utilizes drip irrigation system, with filter, pressure reducer, controller, fertilizer injection assembly. Main tubing running vertically along every other rail, with multi-outlet drip emitters located at each course of modules. Route drip tubing from multi-outlet emitter to top of module (3 tubes per module).

C. Planting Media – specification by others, depending upon location and available components. Typical media utilizes lightweight 95% inorganic mix, largely of calcine clay, slate, sand, perlite or vermiculite. Maximum saturated weight should be less than 50 lbs/cu. ft. Additional water retention materials may be added as required.

PART 3- EXECUTION

3.1 PREPARATION

A. The living wall modules should be transported, unassembled, to the nursery or location where they will be planted and grown in. Modules should be assembled (without top), the soil rention bag placed inside and filled with planting media. Care should be taken that bag is as full as possible. Bag is to be folded over, and top attached. Modules should be planted on their back in the nursery, and grown in for 1-3 months. Proper grow-in is essential for retaining plants in modules when they are mounted vertically.

B. Contractor to inspect the mounting location, to determine correct positioning of mounting rails, irrigation plumbing. Verify anchors specified will support load, and that wall is sufficiently prepared for Tournesol VGM system.

3.2 INSTALLATION

A. Mount rails on building or steel structure, starting with end rail and using assembled module with brackets as template for adjacent rails.

B. Install irrigation system per plans and specifications prior to mounting planted VGM modules.

C. Transport planted modules to project site, then install brackets on each module. Start with lowest course, work towards top. Hang bracket/module unit on rail, then install final irrigation tubing prior to moving to next row.

END OF SECTION 329300.21

SECTION 334100 – STORM UTILITY DRAINAGE PIPING

PART 1 -GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipe and fittings.
2. Cleanouts.
3. Manholes.
4. Catch basins.
5. Stormwater inlets.
6. Drains.
7. Encasement for piping.
8. Channel drainage systems.
9. Stormwater detention and treatment structures.
10. Pipe outlets.

1.3 DEFINITIONS

A. RCP: Reinforced Concrete Pipe.

B. HDPE: High Density Polyethylene

C. PVC: Poly Vinyl Chloride

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. Manholes: Include plans, elevations, sections, details, frames, and covers.
2. Catch basins, storm water inlets and water quality vaults. Include plans, elevations, sections, details, frames, covers, and grates.
3. Stormwater Detention and Treatment Vaul Structures: Include plans, elevations, sections, details, frames, covers, design calculations, and concrete design-mix reports.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from storm drainage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.

B. Field quality-control reports.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes according to manufacturer's written rigging instructions.

D. Handle catch basins according to manufacturer's written rigging instructions.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of service.

2. Do not proceed with interruption of service without Construction Manager's written permission.

PART 2 -PRODUCTS

2.1 PE PIPE AND FITTINGS

A. Corrugated PE Drainage Pipe and Fittings N-12 WT 1B.

2.2 PVC PIPE AND FITTINGS

A. PVC Profile Sewer Piping:

1. Pipe: ASTM F 794, PVC profile, gravity sewer pipe with bell-and-spigot ends for gasketed joints.

2. Fittings: ASTM D 3034, PVC with bell ends.

3. Gaskets: ASTM F 477, elastomeric seals.

2.3 CONCRETE PIPE AND FITTINGS

B. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76 (ASTM C 76M).

1. tongue-and-groove ends and gasketed joints with ASTM C 443 (ASTM C 443M), rubber gaskets]
2. Class II, Wall C.

2.4 CLEANOUTS

A. Plastic Cleanouts:

1. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.5 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105.

B. Material: Linear low-density polyethylene film of 0.008-inch or high-density, cross-laminated polyethylene film of 0.004-inch minimum thickness.

C. Form: Sheet or tube.

D. Color: Black.

2.6 MANHOLES

A. Standard Precast Concrete Manholes:

1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.

2. Diameter: 48 inches minimum unless otherwise indicated.

3. Ballast: Increase thickness of precast concrete sections or add concrete to base section as required to prevent flotation.

4. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.

5. Riser Sections: 4-inch minimum thickness, and lengths to provide depth indicated.

6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated, and top of cone of size that matches grade rings.

7. Joint Sealant: ASTM C 990, bitumen or butyl rubber.

8. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.

9. Steps: Individual FRP steps or ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12-to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches.

10. Adjusting Rings: Interlocking HDPE rings with level or sloped edge in thickness and diameter matching manhole frame and cover, and of height required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.

11. Grade Rings: Reinforced-concrete rings, 6-to 9-inch total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Manhole Frames and Covers:

1. Description: Ferrous; 24-inch ID by 7-to 9-inch riser with 4-inch-minimum width flange and 26¬inch-diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."

2. Material: ASTM A 48/A 48M, Class 35 gray iron unless otherwise indicated.

2.7 CONCRETE

A. General: Cast-in-place concrete according to ACI 318, ACI 350/350R, and the following:

1. Cement: ASTM C 150, Type II.

2. Fine Aggregate: ASTM C 33, sand.

3. Coarse Aggregate: ASTM C 33, crushed gravel.

4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.

2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.

1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.

a. Invert Slope: 2 percent through manhole.

2. Benches: Concrete, sloped to drain into channel.

a. Slope: 8 percent.

D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.

2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

2.8 CATCH BASINS

A. Standard Precast Concrete Catch Basins:

1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.

2. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.

3. Riser Sections: 4-inch minimum thickness, 48-inch diameter, and lengths to provide depth indicated.

4. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.

5. Joint Sealant: ASTM C 990, bitumen or butyl rubber.

6. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and shape matching catch basin frame and grate. Include sealant recommended by ring manufacturer.

7. Grade Rings: Include two or three reinforced-concrete rings, of 6-to 9-inch total thickness, that match 24-inch-diameter frame and grate.

8. Steps: Individual FRP steps or ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12-to 16-inch intervals. Omit steps if total depth from floor of catch basin to finished grade is less than 60 inches.

9. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.

B. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Include flat grate with small square or short-slotted drainage openings.

1. Size: As noted.

2. Grate Free Area: Approximately 50 percent unless otherwise indicated.

3. Grates shall be ADA compliant.

2.9 STORMWATER INLETS

A. Curb Inlets: Made with vertical curb opening of materials and dimensions according to Regional Standard Drawings.

B. Frames and Grates: Heavy duty according to Regional Standard Drawings.

2.10 STORMWATER DETENTION AND TREATMENT STRUCTURES

A. Pre-Cast Concrete, Stormwater Detention and Treatment Structures: Detention Vaults shall be Storm Prism by Forterra, Treatment Vaults shall be MWS –(MODEL)-V-UG. See plans for sizes volume and model.

B. Constructed of reinforced-concrete bottom, walls, and top; designed according to ASTM C 890 for A-16 (AASHTO HS20-44), heavy-traffic, structural loading; of depth, shape, dimensions, and appurtenances indicated.

1. Ballast: Increase thickness of concrete as required to prevent flotation.

2. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch (150- to 229-mm) total thickness, that match 24-inch- (610-mm-) diameter frame and cover.

3. Steps: FRP steps wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch (300- to 400-mm) intervals. Omit steps if total depth from floor of structure to finished grade is less than 60 inches

4.

C. Manhole Frames and Covers: ASTM A 536, Grade 60-40-18, ductile-iron castings designed for heavy-duty service. Include 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser with 4-inch (102-mm) minimum width flange, and 26-inch- (660-mm-) diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."

2.11 PIPE OUTLETS

A. Head Walls: Cast-in-place reinforced concrete, with apron and tapered sides.

B. Riprap Basins: Broken, irregularly sized and shaped, graded stone according to NSSGA's "Quarried Stone for Erosion and Sediment Control."

1. Average Size: NSSGA No. R-5, screen opening 5 inches (127 mm).

C. Filter Stone: According to NSSGA's "Quarried Stone for Erosion and Sediment Control," No. FS-2, No. 4 screen opening, average-size graded stone.

D. Energy Dissipaters: According to NSSGA's "Quarried Stone for Erosion and Sediment Control," No. A-1, 3-ton (2721-kg) average weight armor stone, unless otherwise indicated.

PART 3 -EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.

F. Install gravity-flow, nonpressure drainage piping according to the following:

1. Install piping pitched down in direction of flow.

2. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure drainage piping according to the following:

1. Join corrugated PE piping according to ASTM D 3212 for push-on joints.

2. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasketed joints.

3. Join dissimilar pipe materials with nonpressure-type flexible couplings.

3.4 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.

2. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.

3. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.

4. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads.

A. Set cleanout frames and covers with tops flush with surrounding surface.

3.5 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections with sealants according to ASTM C 891.

C. Where specific manhole construction is not indicated, follow manhole manufacturer's written instructions.

D. Set tops of frames and covers flush with finished surface.

3.6 CATCH BASIN INSTALLATION

A. Construct catch basins to sizes and shapes indicated.

B. Set frames and grates to elevations indicated.

3.7 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318.

3.8 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Section 221413 "Facility Storm Drainage Piping."

B. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.

b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

4. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

C. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.

a. Unshielded flexible couplings for same or minor difference OD pipes.

b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.

c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

3.9 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:

1. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

B. Backfill to grade according to Section 312000 "Earth Moving."

3.10 IDENTIFICATION

A. Materials and their installation are specified in Section 312000 "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.

1. Use detectable warning tape over ferrous piping.

2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.11 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.

2. Defects requiring correction include the following:

a. Alignment: Less than full diameter of inside of pipe is visible between structures.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.

4. Re inspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.

2. Test completed piping systems according to requirements of authorities having jurisdiction.

3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.

4. Submit separate report for each test.

5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:

a. Exception: Piping with soiltight joints unless required by authorities having jurisdiction.

b. Option: Test plastic piping according to ASTM F 1417.

c. Option: Test concrete piping according to ASTM C 924.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.12 CLEANING

A. Clean interior of piping of dirt and superfluous materials. Flush with water.

END OF SECTION 334100