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Seattle
Pier 56, 1201 Alaskan Way #200
Seattle, WA 98101

San Francisco
585 Howard Street #300
San Francisco, CA 94105

Los Angeles
758 New High Street #100B
Los Angeles, CA 90012

DSA A#03-125592
FILE NO. 56-C1

INCREMENT 02

Specifications

Ventura College Student Housing

100% Construction Documents
30 SEPTEMBER 2026

MITHŪN

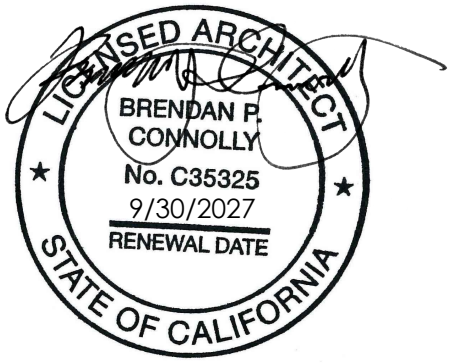
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IDENTIFICATION STAMP
DIV. OF THE STATE ARCHITECT
APP: 03-125592 INC: 02
REVIEWED FOR
SS ☑ FLS ☑ ACS ☑
DATE: 10/13/2026

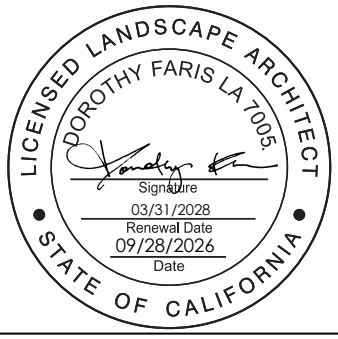
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ARCHITECT



CIVIL ENGINEER



LANDSCAPE ARCHITECT

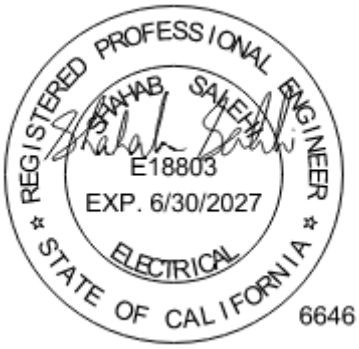


EXP. DATE: 06/30/2027

STRUCTURAL ENGINEER



MECHANICAL ENGINEER
PLUMBING ENGINEER



ELECTRICAL ENGINEER



FIRE ALARM AND
FIRE SPRINKLER ENGINEER

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SECTION 01 10 00 - SUMMARY

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Owner-furnished, Contractor-installed products.
4. Contractor-furnished, Owner-installed products.
5. Specification and drawing conventions.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to the Work of all Sections in the Specifications. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all.

B. Conflicts or discrepancies among the Contract Documents shall be resolved in the following order of priority:

1. Contract modifications (such as Change Orders and Bulletins) of a later date take precedence over those of an earlier date;
2. The Agreement;
3. Addenda of a later date take precedence over those of an earlier date;
4. The Supplementary Conditions;
5. The General Conditions;
6. Drawings and Specifications; Drawings govern Specifications for quantity and location. Specifications govern Drawings for quality and performance. In the event of ambiguity or conflicts, the greater quantity and the better quality shall govern.

1.3 PROJECT INFORMATION

A. Project Identification: Ventura College Student Housing, Project: 2423800.

1. Project Location: 4667 Telegraph Road, Ventura CA 93003.

B. Owner: Ventura Community College, Owner's Representative: James Zavas, VP of Business & Admin Services, & Jesse Sluder, Director of Facilities, Maintenance & Operations, 805.289.6235

C. Architect: Mithun/RND, Simone Barth, Principal 323.591.626.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. Construction of Student Housing at Ventura College.

1. The project consists of a single building with a three- and a four-story massing with a secured outdoor courtyard.

2. The building is a type V-A, wood framed single building, featuring an enclosed heavy timber CLT connector between the two residential bars.

3. Project program includes student rooms, communal bathrooms, shared kitchens, dining and lounges on every floor. Resident support spaces include mail, trash and housekeeping, laundry rooms, and utility spaces.

4. Ground floor communal spaces are configured around the courtyard, creating a contiguous area with the main lobby and include the laundry, study, shared kitchen, dining and lounge.

1.5 PHASED CONSTRUCTION

A. The Work shall be conducted in one phase:

1. Increment 01: Rough grading, site utilities.
2. Increment 02: Building, fine grading, hardscape, walks, landscaping and site walls.

B. This project has been designed to be in compliance with the alternative DSA-SS/CC Community College provisions of the California Building Code.

1.6 OWNER-FURNISHED, CONTRACTOR-INSTALLED PRODUCTS

A. Owner will furnish the products indicated. The Work includes receiving, unloading, handling, storing, protecting, and installing Owner-furnished products and making building services connections.

1.7 CONTRACTOR-FURNISHED, OWNER-INSTALLED PRODUCTS

A. Contractor shall furnish products indicated. The Work includes unloading, handling, storing, and protecting Contractor-furnished products as directed and turning them over to Owner at Project closeout.

1.8 SPECIFICATION AND DRAWING CONVENTIONS

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

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
2. Specification requirements are to be performed by the Contractor unless specifically stated otherwise.

B. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.
3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 10 00

SECTION 01 14 00 - WORK RESTRICTIONS

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. Existing utility interruptions.
2. Use of premises.
3. Occupancy requirements during construction.
4. Occupancy requirements prior to Substantial Completion.
5. Miscellaneous restrictions.

1.3 USE OF PREMISES

A. Access: At all times, provide the Architect and the Owner's representatives, easy and safe access to the Work wherever it is in preparation and progress. Provide such access so Architect may perform its functions. Provide access to any testing agencies to perform required testing.

B. Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

C. On-Site Work Hours: Limit work in the existing building to normal business working hours, Monday through Friday, unless otherwise indicated.

1.4 MISCELLANEOUS RESTRICTIONS

A. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.

1. Notify Owner not less than two days in advance of proposed disruptive operations.
2. Obtain Owner's written permission before proceeding with disruptive operations.

B. Controlled Substances: Use of tobacco products and other controlled substances on Project site is not permitted.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 14 00

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.

1.3 DEFINITIONS

A. Allowance: A quantity of work or dollar amount included in the Contract, 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, or purchase and delivery, of each product or system described by an allowance must be completed by the Owner 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 LUMP-SUM 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 ordered by Owner or selected by Architect 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.

1.8 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, required maintenance materials, 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 markups.

B. Submit claims for increased costs due to a change in the 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

1. Lump-Sum Allowance: This allowance includes, material, receiving, handling, and installation costs, and Contractor overhead and profit. Each item includes design coordinated with the Architect unless otherwise indicated.
    a. Lump-Sum Allowance No. 1: Include the sum of $15,000.00 for one monument sign.
    b. Lump-Sum Allowance No. 2: Include the sum of $15,000.00 for two ground-mounted signs.
    c. Lump-Sum Allowance No. 3: Include the sum of $5,000.00 for five directional signs at the parking lot.
    d. Lump-Sum Allowance No. 4: Include the sum of $2,500.00 for one campus map locator sign.
    e. Lump-Sum Allowance No. 5: Include the sum of $10,000.00 for one entry canopy mounted sign and associated lighting, designed by Architect.
    f. Lump-Sum Allowance No. 6: Include the sum of $25,000.00 for large building-mounted lighted specialty custom signage designed by Architect. Location – east facing wall.
    g. Lump-Sum Allowance No. 7: Include the sum of $100,000 for the design, installation and testing of an Emergency Responder Radio Coverage system if required to facilitate acceptable radio communications within and around the project in compliance with the City of Ventura Fire Department’s requirements. Refer to note on sheet G3.20.

END OF SECTION 012100

SECTION 012300 - ALTERNATES

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 alternates.

1.3 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include, as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation, whether or not indicated as part of alternate.

B. Execute accepted alternates under the same conditions as other Work of the Contract.

C. Schedule: A Part 3 "Schedule of Alternates" Article is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Deductive Alternate No. 1: Reduced Parking Lot.

1. Base Bid: Entire project scope as indicated on Drawings and in Specifications.
2. Alternate: Reduce parking lot scope contract value by 50 percent.

B. Deductive Alternate No. 2: Reduced Building Area.

1. Base Bid: Entire project scope as indicated on Drawings and in Specifications.
2. Alternate: Reduce building south wing by two bays, remove scope between grid lines S07 & S08 and between grid lines S12 & S13.

END OF SECTION 012300

SECTION 01 25 00 - 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 substitutions.

B. Related Sections:

1. Section 01 60 00 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.
2. Divisions 02 through 49 Sections for specific requirements and limitations for substitutions.

1.3 DEFINITIONS

A. 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.
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 facsimile of "Substitution Request" form provided in Document 00 60 00 "Forms."
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, necessary to accommodate proposed substitution.
c. 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.
d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. Certificates and qualification data, where applicable or requested.
g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES and local regulations.
j. 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.
k. Cost information, including a proposal of change, if any, in the Contract Sum.
l. 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.
m. 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 seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

a. Forms of Acceptance: Change Order, Construction Change Directive, or Bulletin for minor changes in the Work.
b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

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

1.6 PROCEDURES

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

PART 2 - PRODUCTS

2.1 DSA COORDINATION:

A. Any substitutions affecting DSA regulated items shall be considered as a Construction Change Document (CCD) or Addenda, and shall be stamped and signed by the Architect and approved by DSA prior to fabrication and installation. (IR A-6 and Section 4-338 (c), Part 1). Refer to Section 012600 "Contract Modification Procedures" for CCD requirements.

2.2 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately upon 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 the 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 the necessary approvals of the 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.

B. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days after commencement of the Work. 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 is consistent with the Contract Documents and will produce indicated results.
   c. Requested substitution provides sustainable design characteristics that specified product provided.
   d. Substitution request is fully documented and properly submitted.
   e. Requested substitution will not adversely affect Contractor's construction schedule.
   f. Requested substitution has received necessary approvals of authorities having jurisdiction.
   g. Requested substitution is compatible with other portions of the Work.
   h. Requested substitution has been coordinated with other portions of the Work.
   i. Requested substitution provides specified warranty.
   j. 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.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 25 00

SECTION 01 26 00 - 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 01 25 00 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

1.3 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. Bulletins with "Architect's Request for Contractor's Proposal" indicated, issued by Construction Manager are not instructions either to stop work in progress or to execute the proposed change.
2. Within time specified in Bulletin after receipt of Bulletin, 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.
    e. Quotation Form: Use forms acceptable to Architect.

B. Contractor-Initiated Proposals (Change Order Request): If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Construction Manager.

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 01 25 00 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use form acceptable to Architect.

1.4 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Work Changes Proposal Request, Construction Manager will issue a Change Order for signatures of Owner and Contractor on District's approved form.

1.5 CONSTRUCTION CHANGE DOCUMENT (CCD)

A. Any changes to approved contract documents relating to the Division of the State Architect's (DSA) scope of review will be made by Construction Change Document (CCD) and submitted to DSA for review and approval. CCDs must be signed by the Architect of Record, Structural Engineer (when applicable), Delegated Professional Engineer (when applicable) and DSA.

1.6 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Construction Manager may issue a Construction Change Directive on AIA Document G714 or similar. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive. After completion of change, submit

an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 26 00

SECTION 01 26 13 - REQUESTS FOR INTERPRETATION (RFI)

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Requests for Interpretation.

B. If any conflicts or inconsistencies exist between the specifications and the drawings (including the general notes), more stringent requirements shall take precedence.

1.2 DEFINITIONS

A. Requests for Interpretation (RFI): Contractor-initiated written instrument related to the execution of the Work that is addressed to the Architect and Owner. The RFI shall be used by the Contractor as the means to ask questions related to the Work, subject to the conditions contained within this Section.

1.3 ACTION SUBMITTALS

A. Requests for Interpretation: Include a detailed, legible description of an 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. Reference to appropriate documents:
    a. Specification Section number and title and related paragraphs.
    b. Drawing number and detail references
    c. Schedule.
    d. Bulletin number.
    e. Other Contract Documents, if any.
9. Field dimensions and conditions, as appropriate.
10. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI. RFI will be returned without answer if estimated Contract Time and Contract Sum are identified.
11. Contractor's signature.

12. 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.

B. RFI Forms: Use "Request for Interpretation" form bound in Document 00 60 00 "Project Forms." Software-generated form with substantially the same content as indicated above, acceptable to Architect.

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

1.4 INFORMATIONAL SUBMITTALS

C. RFI Log: Prepare, maintain, and submit a tabular log of RFI 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.

1.5 QUALITY ASSURANCE

D. Authorship: Prior to the commencement of the RFI process, designate a full time "RFI Manager" whose duties shall include the responsibility for enforcing the Request for Interpretation provisions of this Section, to maintain an up-to-date log of all RFI, advise the Architect and Construction Manager, in writing, of the status and disposition of all RFI at the progress meetings, and be a member of the Contractor's staff. The RFI Manager shall be experienced in the administration and supervision of the type of Work indicated on the Contract Documents.

1. RFI Manager may be the Contractor's Job Superintendent.
2. Each RFI shall originate solely from the RFI Manager. An RFI submitted to the Architect and Construction Manager by an entity, or individual, other than the RFI Manager shall be returned to the Contractor.

1.6 ADMINISTRATIVE REQUIREMENTS

E. Processing Time: Allow five working days for Architect's response for each RFI. RFI received by Architect after 3:00 p.m. will be considered as received the following

business day.

1. Allow additional time if coordination with other work is required. Architect will advise Contractor when an RFI being processed must be delayed for coordination.
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.

F. Architect's action on RFI that may result in a change to the Contract Time or the Contract Sum may be eligible for the Contractor to submit Proposal Request according to Section 01 26 00 "Contract Modification Procedures."

1. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect and Owner in RFI.

G. Frivolous RFI: RFI shall not be used for the following:

a. Request for approval of submittals.
b. Request approval of substitutions.
c. Requests for approval of Contractor's means and methods.
d. Request for adjustment in the Contract Time or the Contract Sum.
e. Requests for interpretation of Architect's actions on submittals.
f. Requests for coordination information already indicated in the Contract Documents, or to transfer coordination responsibility from the Contractor to the Owner or Architect.

2. The Owner reserves the right to assess the Contractor for the cost (based on time and materials) of an RFI response performed by the Architect or Construction Manager, and any of its consultants, which is deemed by the Owner and the Architect or Construction Manager as being frivolous or unnecessary.
3. Frivolous RFI shall be removed from the RFI log.

1.2 COORDINATION

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

1. Submit RFI with such promptness as to cause no delays in the Work. No adjustments of Contract Time or Contract Sum will be granted because of failure to have an RFI submitted with sufficient time to allow for the orderly processing of a response by the Architect.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 CONTRACTOR'S ACTION

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

B. Prior to submission of the RFI, coordinate the nature of the inquiry with the requirements of other Sections or trades as related thereto and responses to previous RFI.

C. Complete each blank on the RFI form.

D. In preparing each RFI, verify the applicable dimension(s), field conditions, Drawing requirements (small through large-scale details), and/or Specification Section requirements pertaining thereto.

E. Each RFI shall be reviewed and signed by the RFI Manager prior to transmitting to the Architect.

F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.

3.2 ARCHITECT'S ACTION

A. Architect's Action: Architect will review each RFI, determine action required, and respond.

1. Frivolous RFI will be returned without action.

B. RFI that fail to conform to requirements (for example, is incomplete or contain numerous errors) shall be returned to the Contractor without a response. No adjustments for Contract Time or Contract Sum shall be granted for an RFI failing to conform to requirements.

END OF SECTION 01 26 13

SECTION 01 29 00 - 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. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. Related Sections include the following:

1. Section 01 26 00 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
2. Section 01 32 00 "Construction Progress Documentation" for administrative requirements governing preparation and submittal of Contractor's Construction Schedule.

1.3 DEFINITIONS

A. Site Visit: Architect's visits to the site at intervals necessary in the judgment of Architect to become generally familiar with the progress and quality of the Work completed and to determine in general if the Work completed is in accordance with the Contract Documents. Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work.

B. 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. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:

a. Application for Payment forms with Continuation Sheets.
b. Submittals Schedule.
c. 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.

B. Format and Content: Use the 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. Project Manager's name and address.
   e. Contractor's name and address.
   f. 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 the Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of Contract Sum. Break down principal subcontract amounts into separate labor and materials items. Breakdown of subcontractor's schedule of values must be true and accurate.
5. Round amounts to the 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. Include evidence of insurance or bonded warehousing if

required.

7. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
8. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
9. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

    a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.

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 Construction Manager and paid for by Owner.

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

B. Payment Application Times: The date of 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. Payment Application 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 of work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at the time of Application for Payment.
    3. Include amounts of Change Orders and Construction Change Directives issued before last day of the construction period covered by application.
    4. Indicate separate amounts for work being carried out under Owner-requested project acceleration, if any.

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 off-site.

1. Provide description of item(s) being stored.
2. Location of the bonded warehouse(s) where materials or equipment is stored.
3. Bill of sale made to Owner stating there will be no additional cost for transportation and delivery of the stored item(s).
4. Statement certifying that item or any part thereof will not be installed in any construction other than Work under this Contract.
5. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
6. 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.
7. Provide summary documentation for stored materials indicating the following:

    a. Materials previously stored and included in previous Applications for Payment.
    b. Work completed for this Application utilizing previously stored materials.
    c. Additional materials stored with this Application.
    d. Total materials remaining stored, including materials with this application.

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

1. List of subcontractors, principal suppliers and fabricators.
2. Schedule of Values.
3. Contractor's Construction Schedule (preliminary if not final).
4. Combined Contractor's construction schedule (preliminary if not final) incorporating the Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
5. Products list (preliminary if not final).
6. Schedule of unit prices.
7. Submittals Schedule (preliminary if not final).
8. List of Contractor's staff assignments.
9. List of Contractor's principal consultants.
10. Copies of building permits.
11. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
12. Initial progress report.
13. Report of preconstruction conference.
14. Certificates of insurance and insurance policies.
15. Performance and payment bonds.
16. Data needed to acquire the Owner's insurance.
17. Initial settlement survey and damage report if required.
18. Construction waste management program.

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

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

H. Final Payment Application: 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, including, but not limited to:

   a. Transmittal of required Project Record Documents to Owner.
   b. Evidence of completion of demonstration and training.

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, "Contractor's Affidavit of Payment of Debts and Claims."
5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
6. AIA Document G707, "Consent of Surety to Final Payment."
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.
9. Final liquidated damages settlement statement.
10. Occupancy permits and similar approvals or certifications by governing authorities and franchised services, assuring Owner's full access and use of completed work.

1.6 REVIEW OF APPLICATION FOR PAYMENT

A. Draft Copy: Submit draft (pencil) copy of the Application for Payment ten days prior to due date for review by Architect.

B. The Architect will rely on the accuracy and completeness of the information furnished by the Contractor. Issuance of a Certificate of Payment will not be deemed to represent that the Architect performed audits of the supporting data.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)
END OF SECTION 01 29 00

SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1. General project coordination procedures.
2. Conservation.
3. Coordination Drawings.
4. Project Web site.
5. Administrative and supervisory personnel.
6. Project meetings.

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

C. Project communication from the contractor must be through the Owner or copying the Owner when directed to the Architect. When directing communication and questions to the Architect's consultants, all communication must be to the Architect, unless otherwise permitted by the Architect. No communication from the contractor or from the contractor's subs shall be permitted to the Architect's consultants, including but not limited to Structural, Mechanical, Plumbing, Electrical, Low Voltage, Civil, Landscape, Food Service, AV/IT, Security, Fire Alarm, and Fire Protection. Any communication between the contractor or the contractor's sub directly with the consultants, leading to changes will be at the sole responsibility and costs of the contractor to make any and all corrections deviating from approved plans.

D. Related Sections: The following Sections contain requirements that relate to this Section:

1. Section 01 32 00 "Construction Progress Documentation" for preparing and submitting the Contractor's Construction Schedule.
2. Section 01 73 00 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.

3. Section 01 77 00 "Closeout Procedures" for coordinating Contract closeout.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities or as specified in individual Sections.

1. Indicate relationship of components shown on separate Shop Drawings.
2. Indicate required installation sequences.
3. Refer to Divisions in the Facility Services Subgroup for specific Coordination Drawing requirements for mechanical and electrical installations.

B. 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. Use CSI Form 1.5A in Document 00 60 00 "Forms." 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.

C. 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 home, 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, on Project Web site, and by each temporary telephone. Keep list current at all times.

1.4 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in various 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.
4. Arrange pipes, ducts, conduits, and other overhead systems in an orderly manner when indicated to remain exposed.

B. If necessary, 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.

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

1. Preparation of 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.

D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

1.5 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. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.

c. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
d. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
e. Indicate required installation sequences.
f. 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 01 33 00 "Submittal Procedures."

C. Coordination Digital Data Files: Not a requirement of the contract documents. If sub-contractor prefers to prepare Coordination Digital Files, or requests digital files for use in preparation of shop drawings, follow the following requirements:

1. Architect will furnish Contractor one set of 2D AutoCAD digital data files of Drawings for use in preparing coordination digital data files if requested.
   a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
   b. Contractor will be solely responsible for model preparation with all sub-contractors in preparation of coordination drawings and conflict resolution.
   c. Digital data files will be provided in 2D AutoCAD format. Translations to different programs or modifications to the drawing setup will be the responsibility of the Contractor.
   d. Contractor shall execute a data licensing agreement for each sub-contractor requesting digital files using the Data Transfer Agreement provided byArchitect.
   e. The use of digital file is for coordination only. Any use in construction, generating Requests for Interpretation (RFI), changes, generating quantity take-offs, cost estimates and fabrication is prohibited and will be at the Contractor's sole risk.
   f. To the extent of any conflict between information contained in, or generated by, the digital files and the Architect's drawings and specifications, that latter documents will prevail.

1.6 PROJECT WEB SITE

A. Use Construction Manager's Project Web site for purposes of hosting and managing project communication and documentation until Final Completion. Project Web site shall include the following functions:

1. Project directory.
2. Project correspondence.

3. Meeting minutes.
4. Contract modifications forms and logs.
5. RFI forms and logs.
6. Schedule and calendar management.
7. Submittals forms and logs.
8. Payment application forms.
9. Drawing and specification document hosting, viewing, and updating.

B. On completion of Project, provide one complete archive copy(ies) of Project Web site files to Owner and to Architect in a digital storage format acceptable to Architect.

1.7 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated. Meetings may be held virtually if agreed upon in advance by Architect and Owner.

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: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
4. Notification: Inform participants three days prior to meetings not regularly scheduled.

B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 10 days after execution of the Agreement.

1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; manufacturers; suppliers; testing laboratory representatives; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect progress, including the following:

    a. Requirements in individual Specification Sections for preconstruction responsibilities.
    b. Tentative construction schedule.
    c. Project coordination
    d. Critical work sequencing and long-lead items.
    e. Designation of key personnel and their duties.
    f. Lines of communication.
    g. Procedures for processing Requests for Interpretation (RFIs.)

h. Procedures for processing Bulletins.
i. Procedures for processing submittals.
j. Procedures for processing substitution requests.
k. Procedures for processing field decisions, proposal requests and Change Orders.
l. Procedures for testing and inspecting.
m. Procedures for processing Applications for Payment.
n. Distribution of the Contract Documents.
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. Equipment deliveries and priorities.
y. First aid.
z. Security.
aa. Progress cleaning.

3. Minutes: Entity responsible for conducting meeting 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, and the Owner's Commissioning Authority of scheduled meeting dates.
2. Agenda: Review of the 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 RFI.
d. Related Change Orders.
e. Purchases.
f. Deliveries.
g. Submittals.
h. Review of mockups.
i. Possible conflicts.
j. Compatibility requirements.
k. Time schedules.
l. Weather limitations.

m. Manufacturer's written instructions.
n. Warranty requirements.
o. Compatibility of materials.
p. Acceptability of substrates.
q. Temporary facilities and controls.
r. Space and access limitations.
s. Regulations of authorities having jurisdiction.
t. Testing and inspecting requirements.
u. Installation procedures.
v. Coordination with other work.
w. Required performance results.
x. Protection of adjacent work.
y. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to 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, Owner's Commissioning Authority, 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. Submittal of written warranties.
d. Requirements for preparing operations and maintenance data.
e. Requirements for delivery of material samples, attic stock, and spare parts.
f. Requirements for demonstration and training.
g. Preparation of Contractor's punch list.
h. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
i. Submittal procedures for closeout documents.
j. Coordination of separate contracts.
k. Owner's partial occupancy requirements.

l. Installation of Owner's furniture, fixtures, and equipment.
m. Responsibility for removing temporary facilities and controls.

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

1. Coordinate dates of meetings with preparation of payment requests.
2. 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 conference 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 the status of the 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.
b. Review present and future needs of each entity present, including the following:

1) Interface requirements.
2) Sequence of operations.
3) Resolution of trade component conflicts with other trades.
4) Status of submittals.
5) Deliveries.
6) Off-site fabrication.
7) Access.
8) Site utilization.
9) Temporary facilities and controls.
10) Work hours.
11) Hazards and risks.
12) Progress cleaning.
13) Quality and work standards.
14) Pending changes
15) Status of Change Orders.
16) Pending claims and disputes.
17) Documentation of information for payment requests.
18) Testing and inspection requirements.
19) Status of Request for Information.
20) Other business relating to the Work.

4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present. Include a brief summary, in narrative form, of progress since the previous meeting and report.

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

F. Coordination Meetings: Conduct Project coordination meetings at regular intervals corresponding to Work which needs to be coordinated. 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, Construction Manager, 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 conference 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 the 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 trade component conflicts with other trades.
4) Status of submittals.
5) Deliveries.
6) Off-site fabrication.
7) Access.
8) Site utilization.
9) Temporary facilities and controls.
10) Work hours.
11) Hazards and risks.
12) Progress cleaning.
13) Quality and work standards.
14) Change Orders.

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 01 31 00

SECTION 01 32 00 - 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. Startup construction schedule.
2. Contractor's construction schedule.
3. Daily construction reports.
4. Material location reports.
5. Site condition reports.
6. Special reports.

B. Related Sections include the following:

1. Section 01 29 00 "Payment Procedures" for submitting the Schedule of Values.
2. Section 01 31 00 "Project Management and Coordination" for submitting and distributing meeting and conference minutes.
3. Section 01 33 00 "Submittal Procedures" for submitting schedules and reports.
4. Section 01 40 00 "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 activities are activities on the critical path. They must start and finish on the planned early start and finish times.
2. Predecessor activity is an activity that must be completed before a given activity can be started.
3. Successor Activity: An activity that follows another activity in the network.

B. Cost Loading: The allocation of the schedule of values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum unless otherwise approved by Architect.

C. 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.

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

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

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

1. Float time belongs to Owner.
2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the following activity.
3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

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

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

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

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

K. 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, unless indicated otherwise:

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

B. Startup construction schedule.

1. Approval of a cost-loaded, startup construction schedule will not constitute approval of a schedule of values for cost-loaded activities.

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

1. Submit a working 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.

D. Construction Schedule Updating Reports: Submit with each Application for Payment.

E. Daily Construction Reports: Submit at monthly intervals.

F. Material Location Reports: Submit at monthly intervals.

G. Site Condition Reports: Submit at time of discovery of differing conditions.

H. Special Reports: Submit at time of unusual event.

I. Qualification Data: For scheduling consultant.

1.5 COORDINATION

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

B. 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 parties involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

C. Coordinate Contractor's construction schedule with Owner's construction schedule for Owner's own forces. Revise Contractor's construction schedule, if necessary, after a joint review and mutual agreement. The construction schedule shall then constitute the schedule to be used by Contractor, separate contractors and Owner until subsequently revised.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Time Frame: Extend schedule from date established for commencement of the Work to date of 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 story or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
2. Procurement Activities: Include procurement process activities for long lead items

and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.

3. Submittal Review Time: Include review and resubmittal times indicated in Section 01 33 00 "Submittal Procedures" in schedule. Include selection process activities for finishes and products specified by allowances or specified to be selected during the sample review process. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
4. Startup and Testing Time: Include not less than 15 days for startup and testing.
5. 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.
6. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.
7. Building Flush-Out: Include at least 14 days for building flush-out as indicated in Section 01 81 19 "Indoor Air Quality (IAQ) Management."
8. Demonstration and Training: Training of Owner's personnel as indicated in Section 01 77 00 "Closeout Procedures." Section 01 79 00 "Demonstration and Training."

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

1. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 01 10 00 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
2. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 01 10 00 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.

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, and the following interim milestones:

1. Temporary enclosure and space conditioning.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

A. General: Prepare network diagrams using AON (activity-on-node) format.

B. CPM Schedule: Prepare Contractor's Construction Schedule using a cost- and resource-loaded, 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 30 days after date established for the Notice to Proceed.

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.

C. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the preliminary network diagram, prepare a skeleton network to identify probable critical paths.

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 commissioning.
j. Punch list and final completion.
k. 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.

a. Format: Mark the critical path. Locate the critical path near center of network; locate paths with the most float near the edges.

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

D. 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.

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

1. Contractor or subcontractor and the Work or activity.
2. Description of activity.
3. Principal 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).

F. 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.

2.3 REPORTS

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

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including rain or snow accumulation.
7. Accidents.
8. Meetings and significant decisions.
9. Unusual events (refer to special reports).
10. Stoppages, delays, shortages, and losses.
11. Meter readings and similar recordings.
12. Tests and inspections, including name(s) of testing and inspection agency(ies).
13. Emergency procedures.
14. Orders and requests of authorities having jurisdiction.

15. Change Orders received and implemented.
16. Construction Change Directives received and implemented.
17. Services connected and disconnected.
18. Equipment or system tests and startups.
19. Partial Completions and Occupancies.
20. Substantial Completions authorized.

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

1. Material stored prior to the previous report and remaining in storage.
2. Material stored prior to the previous report and since removed from storage and installed.
3. Material stored following the previous report and remaining in storage.

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

2.4 SPECIAL REPORTS

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

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

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Contractor's Construction Schedule Updating: At monthly intervals, 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 Actual Completion percentage for each activity.
4. Notify Owner and Architect a minimum of one week prior to issuance of updated schedule of all anticipated significant revisions to the Construction Schedule.

B. 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 electronic copies of the updated project schedule on the project website.
2. Post copies in Project meeting rooms and temporary field offices.
3. 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.

END OF SECTION 01 32 00

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 DEFINITIONS

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

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's and Commissioning Agent'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. Informational Submittals will be reviewed for Client Record Only and must be submitted separately from Action Submittals and identified as an Informational Submittal.

C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.

D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.3 ACTION SUBMITTALS

A. Submittal Schedule: Submit a schedule 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 modifications to submittals noted by the 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 start-up 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 dates for installation.
    i. Activity or event number.

5. Architect reserves the right to withhold 10 percent of each payment request, in addition to the retainage fee, if any, until the submittal schedule is received and accepted by the Architect.Initial Submittal Schedule is required before any further submittals will be reviewed.

1.4 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Architect's Digital Data Files: At Contractor's written request, electronic copies of Drawings of the Contract Drawings and Project Manual will be provided by Architect for Contractor's use in preparing submittals and Project record documents.

1. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
2. Execute and submit the Data Transfer Agreement form included in Document 00 60 00 "Project Forms." Do not distribute digital data drawing files prior to transmitting to Architect copies of Data Transfer Agreement signed by each entity requesting the files.

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 Action and Informational submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.

    a. Exception: Where samples for initial selection and samples for

verification are both required, submit samples for verification after initial selection has been returned by Architect.

3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

    a. 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. Architect will document on submittal the date of receipt. Submittals received by Architect after 1:00 p.m. will be considered as received the following working day. 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 days for initial review. Allow additional time if coordination with subsequent submittals is required. Allow 15 days minimum for review of Deferred Submittals. Architect will advise Contractor when a submittal being processed must be delayed for coordination. Delaying submittals to facilitate coordination between submittals shall not constitute a delay of the Work nor shall it be the basis for an extension of time.
2. Concurrent Consultant Review: Transmit submittals directly to Architect. Duration of initial submittal review shall be 15 days for initial review. Submittal will be returned to Architect before being returned to Contractor.
3. If intermediate submittal is necessary, process it in same manner as initial submittal.
4. Allow 15 days for review of each resubmittal.

D. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:

1. Assemble complete submittal package into a single indexed file with links enabling navigation to each item.

    a. Unique identifier, including revision number. Submittals shall be numbered with the Section number, followed by a dash, followed by a three-digit number, followed by a dash, and ending with a sequential submission number as indicated below. The numbering system shall be retained throughout all revisions.

        1) Section Number: Section number where submittal is specified.
        2) Three-Digit Number: Sequential number, beginning with "001," for each submittal transmitted to Architect for each Section.
        3) Submission Number: Use "0" for initial submittal, "1" for first resubmittal, "2" for second resubmittal, and so forth.

4) Example: 061000-001-0 (Section 06 10 00, first submission of the Section, initial submittal).

2. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
3. Scanned Copies: Legible scanned PDF files of paper originals are acceptable. Scanned submittals that are not legible will be rejected.
4. Sheet Orientation: Orient PDF sheets to a "Ready-to-Read" orientation with majority of text horizontal to the sheet with no additional adjustments or formatting required.
5. File Security: Do not set any permissions on the file. Protected documents will not be accepted.
6. Metadata: Include the following information in the electronic submittal file metadata:

    a. Title: Project title
    b. Author: Contractor's name.
    c. Subject: Submittal type (product data, shop drawing, report, etc.)
    d. Keywords: Number and title of appropriate Specification Section; manufacturer name; product name/model number.

7. File Size: Limit file size of each submittal as follows. Break larger PDF files into multiple packages where necessary to meet delivery restrictions. Identify split packages as "1 of #" and "2 of #" in the subject line.

    a. Email Delivery: 2 Megabytes.

E. Options: Identify options requiring selection by Architect.

F. Deviations and Additional Information: On an attached separate document, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect[and Construction Manager] on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

G. 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 stamped with Architect's action stamp marked "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED
4. Costs of compensation for Architect's additional services and expenses made necessary for review of submittals exceeding the limits set forth below shall be at the Contractor's expense.

    a. Reviews of Each Submittal: Two, including initial review.

H. 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.

I. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals with Architect's action stamp marked "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS AS NOTED

J. The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples or similar submittals until the respective submittal has been reviewed by Architect and returned to Contractor with Architect's action stamp marked "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS AS NOTED

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

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

1. Post electronic submittals as PDF electronic files directly to Project Web site specifically established for the Project. Do not post zipped files.

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

2. Submit electronic submittals via email as PDF electronic files. Do not post zipped files.

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

3. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 01 77 00 "Closeout Procedures."
4. Certificates and Certifications Submittals: Provide 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.

    a. Provide a digital signature with digital certificate on electronically-submitted certificates and certifications where indicated.
    b. Provide a notarized statement on original paper copy certificates and certifications where indicated.

5. Systems Submittals: Identify submittals for systems such as fire alarms and fire

protection systems, on the transmittal and act upon the system singularly as a combined submittal. If resubmission is required, resubmit entire system submittal,

B. 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 printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

a. Manufacturer's catalog cuts.
b. Manufacturer's written recommendations.
c. Manufacturer's product specifications.
d. Standard color charts.
e. Mill reports.
f. Standard product operating and maintenance manuals.
g. Compliance with recognized trade association standards.
h. Compliance with recognized testing agency standards.
i. Application of testing agency labels and seals.
j. Notation of coordination requirements.
k. Availability and delivery time information.

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

a. Wiring diagrams showing 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 or concurrent with Samples.
6. Submit Product Data in the following format:

a. PDF electronic file.

C. Shop Drawings: Prepare and submit Project-specific information, drawn accurately to scale. Do not reproduce, digitally or otherwise, the Contract Documents and submit as Shop Drawings. Do not use, copy or reproduce title blocks, dimensions, notes, keynotes, symbols schedules or details from Contract Drawings, digital or otherwise. Use of the Contract Drawings shall be limited to reproduction, digitally or otherwise, of the exterior wall layout, interior partition layout, grid lines, doors, and windows. Do not base Shop Drawings on standard printed data.

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

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

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

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

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Refer to individual Specification Sections for requirements for Samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation, and similar construction characteristics.
3. Identification: Attach label on unexposed side of Samples that includes the following:

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

4. Submit corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
5. 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.

6. 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 one full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line.
   b. Architect will return submittal with options selected.

7. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from the same material to be used for the Work, cured and finished in manner specified, and physically identical with the 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:

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

   b. Architect will retain one Sample set; remainder will be returned. Mark up and retain one returned Sample set as a Project record sample.

8. Preparation: Mount, display, or package Samples in manner specified to facilitate review of qualities indicated. Prepare Samples to match Architect's sample where so indicated. Attach label on unexposed side that includes the following:

   a. Generic description of Sample.
   b. Product name or name of manufacturer.
   c. Sample source.

9. Submit Samples for review of kind, color, pattern, and texture for a final check

of these characteristics with other elements and for a comparison of these characteristics between final submittal and actual component as delivered and installed.

a. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
b. Refer to individual Specification Sections for requirements for Samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation, and similar construction characteristics.

E. Product Schedule or List: Prepare and submit 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 file.

F. Application for Payment and Schedule of Values: Comply with requirements specified in Section 01 29 00 "Payment Procedures."

G. Coordination Drawing Submittals: Comply with requirements specified in Section 01 31 00 "Project Management and Coordination."

H. Subcontract List: Prepare and submit 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. Submit on the form included in Document 00 60 00 "Forms," "Subcontractors and Major Material Suppliers List."

1. Submit subcontract list in the following format:

a. PDF electronic file.

I. Contractor's Construction Schedule: Comply with requirements specified in Section 01 32 00 "Construction Progress Documentation" for action required.

J. Construction Photographs [and Videos]: Comply with requirements in Section 01 32 00 "Construction Progress Documentation."

K. Daily Construction Reports: Comply with requirements specified in Section 01 32 00 "Construction Progress Documentation."

L. Test and Inspection Reports and Schedule of Tests and Inspections Submittals:

Comply with requirements specified in Section 01 40 00 "Quality Requirements."

M. Certified Surveys: Comply with requirements specified in Section 01 73 00 "Execution."

N. Closeout Submittals: Comply with requirements specified in Section 01 77 00 "Closeout Procedures."

O. Operation and Maintenance Data: Submit written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Section 01 77 00 "Closeout Procedures."

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

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

R. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that the manufacturer complies with requirements. Include evidence of manufacturing experience where required.

S. Product Certificates: Submit written statements on manufacturer's letterhead certifying that the product complies with requirements.

T. Material Certificates: Submit written statements on manufacturer's letterhead certifying that the material complies with requirements.

U. 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.

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

W. 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:

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

7. Limitations of use.

X. Preconstruction Test Reports: Prepare and 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.

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

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

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

1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement on the condition of substrates and their acceptability for installation of product.
3. Statement that products at the 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.

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

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

CC. Insurance Certificates and Bonds: Prepare and submit written information indicating current status of insurance or bonding coverage. Include name of entity covered

by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.

DD. Material Safety Data Sheets: If requested by Owner, submit data sheets directly to Owner. Do not submit data sheets to Architect. Architect will not review data sheets and will not return them to Contractor.

EE. Material Maintenance Submittals: Comply with requirements specified in individual Sections for quantity and disposition of delivery of extra stock.

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

2.2 DELEGATED-DESIGN SERVICES

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.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally-signed PDF electronic file paper copies of certificate, 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.

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

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Action 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 and Construction Manager.

B. Project Closeout and Maintenance/Material Submittals: Refer to requirements in Section 01 77 00 "Closeout Procedures."

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

3.2 ARCHITECT'S ACTION

A. General: Architect will not review submittals that have not been properly transmitted, reviewed by Contractor, or do not bear Contractor's approval stamp and will return them without action.

B. Action Submittals: Architect will review submittal, make marks to indicate corrections or revisions required, and return it to Contractor. Architect will stamp each submittal with an action stamp as illustrated at the end of this Section, and will mark stamp appropriately to indicate action, as follows:

1. "NO EXCEPTIONS TAKEN": No further review of Submittal required.

2. "MAKE CORRECTIONS AS NOTED. Resubmittal not required unless Contractor cannot comply with corrections noted.": Incorporate corrections in Work. If Contractor cannot comply with corrections as noted, revise to respond to exceptions and resubmit.
3. "REVISE AS NOTED AND RESUBMIT": Revise as noted and resubmit for further review.
4. "RESUBMIT PROPERLY Submittal not reviewed for reasons noted."
5. "NOT REVIEWED Submittal not required by Contract Documents.": Remove from submittal log.
6. "RECEIVED FOR CLIENT'S RECORD ONLY. Submittal not reviewed."

C. 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.

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

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

F. Submittals not required by the Contract Documents will not be reviewed and may be discarded or returned marked "NOT REVIEWED."

G. Substitution items received as product data, shop drawing, or sample submittals required by individual Sections will be returned to Contractor without review. Comply with requirements in Section 01 25 00 "Substitution Procedures" for submission of substitution request.

END OF SECTION 01 33 00

SECTION 01 40 00 - 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. This 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-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 quality-control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-control services required by Architect, Owner, Commissioning Authority, or authorities having jurisdiction are not limited by provisions of this Section.

C. Related Sections:

1. Section 01 73 00 "Execution" for repair and restoration of construction disturbed by testing and inspecting activities.
2. Divisions 02 through 49 Sections for specific test and inspection requirements.

1.3 DEFINITIONS

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

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that completed construction complies with requirements. Services do not include contract enforcement activities performed by Architect.

C. Mockups: Full-size physical assemblies that are constructed on-site, unless

indicated otherwise. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between 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. Integrated Exterior Mockups: Mockups of the exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies. See Attachment A for mockup drawing.
2. Factory Mockups: Full-size physical assemblies constructed off-site, at fabrication plant.

D. 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.

E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

F. Source Quality-Control Testing: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).

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

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

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

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

J. Experienced: When used with an entity or individual, "experienced" 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.

1.4 CONFLICTING REQUIREMENTS

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

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

1.5 ACTION SUBMITTALS

A. Shop Drawings: For integrated exterior mockups, provide plans, sections, and elevations, indicating materials and size of mockup construction.

1. Indicate manufacturer and model number of individual components.
2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions

1.6 INFORMATIONAL SUBMITTALS

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

B. 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.

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

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

D. Testing Agency and Inspection Reports: Prepare and submit certified written reports that 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. Ambient 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.

E. 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.

F. 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.

1.7 QUALITY ASSURANCE

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

B. Fabricator Qualifications: A firm experienced and expert in producing products similar to those indicated for this Project and with a three-year record of successful in-service performance, as well as sufficient production capacity to

produce required units.

C. 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.

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 three-year record of successful in-service performance.

E. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a five-year record of successful in-service performance.

F. 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.

G. Professional Engineer Qualifications: A professional engineer 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 products that are similar to those indicated for this Project in material, design, and extent.

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

1. Requirement for specialists shall not supersede building codes and similar regulations governing the Work, nor interfere with local trade-union jurisdictional settlements and similar conventions.

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

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

J. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish specified in individual Sections, 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 seven 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 seven days for initial review and each re-review of each mockup.

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

K. Integrated Exterior Mockups: Construct integrated exterior mockup according to approved Shop Drawings and with location as indicated on Drawings. Coordinate installation of exterior envelope materials and products for which mockups are required in individual Specification Sections, along with supporting materials.

1. Engineering for mockup structural support and foundation is by Contractor.
2. See Attachment A for mockup drawing.

L. Factory Mockups: Construct assemblies at fabrication plant prior to shipment to the Project site as specified in individual Sections in Divisions 02 through 33.

1.8 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 employ a Project Inspector approved by the Division of the State Architect who shall provide continuous inspection of the work. The duties of the inspector are defined in section 4-324, part 1, title 24, CCR. The project inspector shall be certified by DSA to inspect Class 1 construction. The inspector shall be approved by the Architect of Record, Structural Engineer, Delegated Professional Engineer (when applicable) and Division of the State Architect.
2. Owner will employ a Testing Agency approved by the Division of the State Architect who shall provide testing services. The duties of the Testing Agency are defined in section 4-213, part 1, title 24, CCR. The Testing agency shall be approved by the Architect of Record, Structural Engineer and Division of the State Architect.
3. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of the types of testing and inspecting they are engaged to perform.
4. Payment for these services will be made from testing and inspecting allowances, as authorized by Change Orders.
5. 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. Verify compliance with Title 24 for parts 1-6 and 9 as applicable.
2. Title 24, Parts 1-5 must be kept on site during construction.
3. 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.
4. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.

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

5. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
6. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
7. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
8. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
9. Provide quality assurance and control services required due to changes in the Work proposed by or made by the Contractor.
10. Provide quality control services for Work done contrary to the Contract Documents, without prior notice, when so specified, or without proper supervision.
11. Overtime expenses and schedule delays accruing as a result of executing quality control services shall be the Contactor's responsibility and shall not be charged to the Owner.

C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 01 33 00 "Submittal Procedures."

D. 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.

E. Retesting/Reinspecting: Regardless of whether original tests or inspections were

Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that revised or replaced Work that failed to comply with requirements established by the Contract Documents. Architect retains the right to require the use of a different testing agency for retesting ad reinspecting.

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

1. Notify Architect, Commissioning Authority, 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 requirements of the Contract Documents or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.
7. Attend Project progress meetings as requested by Architect.

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 inspection. Assist the agency in obtaining samples.
4. Facilities for storage and field-curing of test samples.
5. Delivery of samples to testing agencies or arranging for pick-up of test samples after normal business hours.
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 the sequence of activities to accommodate required quality-assurance and quality 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 schedule concurrently with Contractor's Construction Schedule as specified in Section 01 32 00 "Construction Progress Documentation."

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

1.9 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:

B. Special Tests and Inspections: Conducted by a qualified special inspectors required by authorities having jurisdiction, as indicated in individual Specification Sections, 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, Commissioning Authority, 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 the Architect and Commissioning Authority, with copy to Contractor and to the 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.
7. List of Required Structural Test and Special Inspections - DSA -103.

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, Commissioning Authority'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 Section 01 73 00 "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.

END OF SECTION 01 40 00

SECTION 01 42 00 - 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. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

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

D. "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."

E. "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.

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

G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

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

I. "As Required": As required by regulatory bodies, by referenced standards, by existing conditions, by generally accepted construction practice or by the Contract Documents. In the event of ambiguity or conflicts, the most stringent requirements shall apply.

J. "By Others" refers to work that is not a part of the Contract.

K. "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.

L. "NIC": "Not in Contract" means the work or the item indicated is not a part of the Contract and will be provided by the Owner.

M. "Day": Unless stated otherwise, "day" means a calendar day.

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, except comply with standards having different revision dates as referenced in the codes as indicated on Drawings.

C. Copies of Standards: Each entity engaged in construction on Project must 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 the publication source and make them available on request.

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 in the following list.
Names and Website addresses are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

1. AA; Aluminum Association (The); www.aluminum.org.
2. AAADM; American Association of Automatic Door Manufacturers; www.aaadm.com.
3. AABC; Associated Air Balance Council; www.aabc.com.
4. AAMA; American Architectural Manufacturers Association; www.aamanet.org.
5. AAPFCO; Association of American Plant Food Control Officials; www.aapfco.org.
6. AASHTO; American Association of State Highway and Transportation Officials; www.transportation.org.
7. AATCC; American Association of Textile Chemists and Colorists; www.aatcc.org.
8. ABAA; Air Barrier Association of America; www.airbarrier.org.
9. ABMA; American Bearing Manufacturers Association; www.americanbearings.org.
10. ACI; American Concrete Institute; (Formerly: ACI International); www.concrete.org.
11. ACPA; American Concrete Pipe Association; www.concrete-pipe.org.
12. ADC; Air Diffusion Council; www.flexibleduct.org.
13. AEIC; Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.

14. AF&PA; American Forest & Paper Association; www.afandpa.org.
15. AGA; American Gas Association; www.aga.org.
16. AGC; Associated General Contractors of America (The); www.agc.org.
17. AHA; American Hardboard Association; http://domensino.com/AHA.
18. AHAM; Association of Home Appliance Manufacturers; www.aham.org.
19. AHRI; Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
20. AI; Asphalt Institute; www.asphaltinstitute.org.
21. AIA; American Institute of Architects (The); www.aia.org.
22. AISC; American Institute of Steel Construction; www.aisc.org.
23. AISI; American Iron and Steel Institute; www.steel.org.
24. AITC; American Institute of Timber Construction; www.aitc-glulam.org.
25. ALSC; American Lumber Standard Committee, Incorporated; www.alsc.org.
26. AMCA; Air Movement and Control Association International, Inc.; www.amca.org.
27. ANLA; American Nursery & Landscape Association; www.anla.org.
28. ANSI; American National Standards Institute; www.ansi.org.
29. AOSA; Association of Official Seed Analysts, Inc.; www.aosaseed.com.
30. APA; APA; The Engineered Wood Association; www.apawood.org.
31. APA; Architectural Precast Association; www.archprecast.org.
32. API; American Petroleum Institute; www.api.org.
33. APWA; American Public Works Association; www.apwa.net.
34. ARI; Air-Conditioning & Refrigeration Institute; (See AHRI).
35. ARI; American Refrigeration Institute; (See AHRI).
36. ARMA; Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
37. ASA; Acoustical Society of America; www.acousticalsociety.org.
38. ASC; Adhesive and Sealant Council (The); www.ascouncil.org.
39. ASCA; Architectural Spray Coaters Association.
40. ASCE; American Society of Civil Engineers; www.asce.org.
41. ASCE/SEI; American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
42. ASHRAE; American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
43. ASME; ASME International; (American Society of Mechanical Engineers); www.asme.org.
44. ASPE; American Society of Plumbing Engineers; www.aspe.org.
45. ASSE; American Society of Safety Engineers (The); www.asse.org.
46. ASSE; American Society of Sanitary Engineering; www.asse-plumbing.org.
47. ASTM; ASTM International; (American Society for Testing and Materials International); www.astm.org.
48. ATIS; Alliance for Telecommunications Industry Solutions; www.atis.org.
49. ASCI; Association of the Wall and Ceiling Industry; www.awci.org.
50. AWEA; American Wind Energy Association; www.awea.org.
51. AWI; Architectural Woodwork Institute; www.awinet.org.
52. AWMAC; Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
53. AWPA; American Wood Protection Association; (Formerly: American Wood-Preservers' Association); www.awpa.com.
54. AWS; American Welding Society; www.aws.org.
55. AWWA; American Water Works Association; www.awwa.org.
56. BHMA; Builders Hardware Manufacturers Association; www.buildershardware.com.
57. BIA; Brick Industry Association (The); www.gobrick.com.
58. BICSI; BICSI, Inc.; www.bicsi.org.

59. BIFMA; BIFMA International; (Business and Institutional Furniture Manufacturer's Association); www.bifma.com.
60. BISSC; Baking Industry Sanitation Standards Committee; www.bissc.org.
61. BWF; Badminton World Federation; (Formerly: International Badminton Federation); www.bwfbadminton.org.
62. CCC; Carpet Cushion Council; www.carpetcushion.org.
63. CCFSS; Center for Cold-formed Steel Structures; www.ccfssonline.org.
64. CDA; Copper Development Association; www.copper.org.
65. CEA; Canadian Electricity Association; www.electricity.ca.
66. CEA; Consumer Electronics Association; www.ce.org.
67. CFFA; Chemical Fabrics & Film Association, Inc.; www.chemicalfabricsandfilm.com.
68. CFI; International Certified Floorcovering Installers Association; www.cfi-installers.org.
69. CFSEI; Cold-Formed Steel Engineers Institute; www.cfsei.org.
70. CGA; Compressed Gas Association; www.cganet.com.
71. CIMA; Cellulose Insulation Manufacturers Association; www.cellulose.org.
72. CISCA; Ceilings & Interior Systems Construction Association; www.cisca.org.
73. CISPI; Cast Iron Soil Pipe Institute; www.cispi.org.
74. CLFMI; Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
75. CPA; Composite Panel Association; www.pbmdf.com.
76. CPPA; Corrugated Polyethylene Pipe Association; www.plasticpipe.org/drainage/index.html.
77. CRI; Carpet and Rug Institute (The); www.carpet-rug.org.
78. CRRC; Cool Roof Rating Council; www.coolroofs.org.
79. CRSI; Concrete Reinforcing Steel Institute; www.crsi.org.
80. CSA; Canadian Standards Association; www.csa.ca.
81. CSA; CSA International; (Formerly: IAS; International Approval Services); www.csa-international.org.
82. CSI; Construction Specifications Institute (The); www.csinet.org.
83. CSSB; Cedar Shake & Shingle Bureau; www.cedarbureau.org.
84. CTI; Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.cti.org.
85. CWC; Composite Wood Council; (See CPA).
86. DASMA; Door and Access Systems Manufacturers Association; www.dasma.com.
87. DHI; Door and Hardware Institute; www.dhi.org.
88. ECA; Electronic Components Association; (See ECIA).
89. ECAMA; Electronic Components Assemblies & Materials Association; (See ECIA).
90. ECIA; Electronic Components Industry Association; www.eciaonline.org
91. EIA; Electronic Industries Alliance; (See TIA).
92. EIMA; EIFS Industry Members Association; www.eima.com.
93. EJMA; Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
94. ESD; ESD Association; (Electrostatic Discharge Association); www.esda.org.
95. ESTA; Entertainment Services and Technology Association; (See PLASA).
96. EVO; Efficiency Valuation Organization; www.evo-world.org.
97. FIBA; Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
98. FIVB; Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
99. FM Approvals; FM Approvals LLC; www.fmglobal.com.
100. FM Global; FM Global; (Formerly: FMG; FM Global); www.fmglobal.com.
101. FRSA; Florida Roofing, Sheet Metal & Air Conditioning Contractors Association,

Inc.; www.floridaroof.com.
102. FSA; Fluid Sealing Association; www.fluidsealing.com.
103. FSC; Forest Stewardship Council U.S.; www.fscus.org.
104. GA; Gypsum Association; www.gypsum.org.
105. GANA; Glass Association of North America; www.glasswebsite.com.
106. GBCI; Green Building Certification Institute; www.gbci.org.
107. GS; Green Seal; www.greenseal.org.
108. GSI; Geosynthetic Institute; www.geosynthetic-institute.org.
109. GTA; Glass Tempering Division of Glass Association of North America; (see GANA).
110. HI; Hydraulic Institute; www.pumps.org.
111. HI/GAMA; Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
112. HMMA; Hollow Metal Manufacturers Association; (See NAAMM).
113. HPVA; Hardwood Plywood & Veneer Association; www.hpva.org.
114. HPW; H. P. White Laboratory, Inc.; www.hpwhite.com.
115. IAPSC; International Association of Professional Security Consultants; www.iapsc.org.
116. IAS; International Accreditation Service; www.iasonline.org.
117. IAS; International Approval Services; (See CSA).
118. ICBO; International Conference of Building Officials; (See ICC).
119. ICC; International Code Council; www.iccsafe.org.
120. ICEA; Insulated Cable Engineers Association, Inc.; www.icea.net.
121. ICPA; International Cast Polymer Alliance; www.icpa-hq.org.
122. ICRI; International Concrete Repair Institute, Inc.; www.icri.org.
123. IEC; International Electrotechnical Commission; www.iec.ch.
124. IEEE; Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
125. IES; Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); www.ies.org.
126. IESNA; Illuminating Engineering Society of North America; (See IES).
127. IEST; Institute of Environmental Sciences and Technology; www.iest.org.
128. IGCC; Insulating Glass Certification Council; www.igcc.org.
129. IGMA; Insulating Glass Manufacturers Alliance; www.igmaonline.org.
130. IGSHPA; International Ground Source Heat Pump Association; www.igshpa.okstate.edu.
131. ILI; Indiana Limestone Institute of America, Inc.; www.iliai.com.
132. Intertek; Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
133. ISA; International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); www.isa.org.
134. ISAS; Instrumentation, Systems, and Automation Society (The); (See ISA).
135. ISFA; International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); www.isfanow.org.
136. ISO; International Organization for Standardization; www.iso.org.
137. ISSFA; International Solid Surface Fabricators Association; (See ISFA).
138. ITU; International Telecommunication Union; www.itu.int/home.
139. KCMA; Kitchen Cabinet Manufacturers Association; www.kcma.org.
140. LMA; Laminating Materials Association; (See CPA).
141. LPI; Lightning Protection Institute; www.lightning.org.
142. MBMA; Metal Building Manufacturers Association; www.mbma.com.
143. MCA; Metal Construction Association; www.metalconstruction.org.
144. MFMA; Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.

145. MFMA; Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
146. MHIA; Material Handling Industry of America; www.mhia.org.
147. MIA; Marble Institute of America; www.marble-institute.com.
148. MIA; Masonry Institute of America; www.masonryinstitute.org.
149. MMPA; Moulding & Millwork Producers Association; (Formerly: Wood Moulding & Millwork Producers Association); www.wmmpa.com.
150. MPI; Master Painters Institute; www.paintinfo.com.
151. MSS; Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org.
152. NAAMM; National Association of Architectural Metal Manufacturers; www.naamm.org.
153. NACE; NACE International; (National Association of Corrosion Engineers International); www.nace.org.
154. NADCA; National Air Duct Cleaners Association; www.nadca.com.
155. NAIMA; North American Insulation Manufacturers Association; www.naima.org.
156. NBGQA; National Building Granite Quarries Association, Inc.; www.nbgqa.com.
157. NCAA; National Collegiate Athletic Association (The); www.ncaa.org.
158. NCMA; National Concrete Masonry Association; www.ncma.org.
159. NCPI; National Clay Pipe Institute; www.ncpi.org.
160. NCTA; National Cable & Telecommunications Association; www.ncta.com.
161. NEBB; National Environmental Balancing Bureau; www.nebb.org.
162. NECA; National Electrical Contractors Association; www.necanet.org.
163. NeLMA; Northeastern Lumber Manufacturers Association; www.nelma.org.
164. NEMA; National Electrical Manufacturers Association; www.nema.org.
165. NETA; InterNational Electrical Testing Association; www.netaworld.org.
166. NFHS; National Federation of State High School Associations; www.nfhs.org.
167. NFPA; NFPA; (National Fire Protection Association); www.nfpa.org.
168. NFPA; NFPA International; (See NFPA).
169. NFRC; National Fenestration Rating Council; www.nfrc.org.
170. NGA; National Glass Association; www.glass.org.
171. NHLA; National Hardwood Lumber Association; www.nhla.com.
172. NLGA; National Lumber Grades Authority; www.nlga.org.
173. NOFMA; National Oak Flooring Manufacturers Association; (See NWFA).
174. NOMMA; National Ornamental & Miscellaneous Metals Association; www.nomma.org.
175. NRCA; National Roofing Contractors Association; www.nrca.net.
176. NRMCA; National Ready Mixed Concrete Association; www.nrmca.org.
177. NSF; NSF International; (National Sanitation Foundation International); www.nsf.org.
178. NSPE; National Society of Professional Engineers; www.nspe.org.
179. NSSGA; National Stone, Sand & Gravel Association; www.nssga.org.
180. NTMA; National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
181. NWFA; National Wood Flooring Association; www.nwfa.org.
182. PCA; Portland Cement Association; www.cement.org.
183. PDCA; Painting and Decorating Contractors of America; www.pdca.com.
184. PCI; Precast/Prestressed Concrete Institute; www.pci.org.
185. PDI; Plumbing & Drainage Institute; www.pdionline.org.
186. PGI; PVC Geomembrane Institute; http://pgi-tp.ce.uiuc.edu.
187. PLANET; Professional Landscape Network; www.landcarenetwork.org.

188. PLASA; PLASA; (Formerly: ESTA; Entertainment Services and Technology Association); www.plasa.org.
189. PTI; Post-Tensioning Institute; www.post-tensioning.org.
190. RCSC; Research Council on Structural Connections; www.boltcouncil.org.
191. RFCI; Resilient Floor Covering Institute; www.rfci.com.
192. RIS; Redwood Inspection Service; www.redwoodinspection.com.
193. RMA; Rubber Manufacturers Association; www.rma.org.
194. SAE; SAE International; (Society of Automotive Engineers); www.sae.org.
195. SCTE; Society of Cable Telecommunications Engineers; www.scte.org.
196. SDI; Steel Deck Institute; www.sdi.org.
197. SDI; Steel Door Institute; www.steeldoor.org.
198. SEFA; Scientific Equipment and Furniture Association; www.sefalabs.com.
199. SEI/ASCE; Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
200. SGCC; Safety Glazing Certification Council; www.sgcc.org.
201. SIA; Security Industry Association; www.siaonline.org.
202. SJI; Steel Joist Institute; www.steeljoist.org.
203. SMA; Screen Manufacturers Association; www.smainfo.org.
204. SMACNA; Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
205. SMPTE; Society of Motion Picture and Television Engineers; www.smpte.org.
206. SPFA; Spray Polyurethane Foam Alliance; www.sprayfoam.org.
207. SPIB; Southern Pine Inspection Bureau; www.spib.org.
208. SPRI; Single Ply Roofing Industry; www.spri.org.
209. SRCC; Solar Rating and Certification Corporation; www.solar-rating.org.
210. SSINA; Specialty Steel Industry of North America; www.ssina.com.
211. SSMA; Steel Stud Manufacturers Association; www.ssma.com.
212. SSPC; SSPC: The Society for Protective Coatings; www.sspc.org.
213. STI; Steel Tank Institute; www.steeltank.com.
214. SWI; Steel Window Institute; www.steelwindows.com.
215. SWPA; Submersible Wastewater Pump Association; www.swpa.org.
216. SWRI; Sealant, Waterproofing, and Restoration Institute; www.swrionline.org.
217. TCA; Tilt-Up Concrete Association; www.tilt-up.org.
218. TCNA; Tile Council of North America, Inc.; (Formerly: Tile Council of America); www.tileusa.com.
219. TEMA; Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.
220. TIA; Telecommunications Industry Association; (Formerly: TIA/EIA; Telecommunications Industry Association/Electronic Industries Alliance); www.tiaonline.org.
221. TIA/EIA; Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
222. TMS; The Masonry Society; www.masonrysociety.org.

223. TPI; Truss Plate Institute; www.tpinst.org.
224. TPI; Turfgrass Producers International; www.turfgrasssod.org.
225. TRI; Tile Roofing Institute; (Formerly: National Tile Roofing Manufacturing Association); www.tileroofing.org.
226. UBC; Uniform Building Code; (See ICC).
227. UFAC; Upholstered Furniture Action Council; www.ufac.org.
228. UL; Underwriters Laboratories Inc.; www.ul.com.
229. UNI; Uni-Bell PVC Pipe Association; www.uni-bell.org.
230. USAV; USA Volleyball; www.usavolleyball.org.
231. USGBC; U.S. Green Building Council; www.usgbc.org.
232. USITT; United States Institute for Theatre Technology, Inc.; www.usitt.org.
233. WASTEC; Waste Equipment Technology Association; www.wastec.org.
234. WCLIB; West Coast Lumber Inspection Bureau; www.wclib.org.
235. WCMA; Window Covering Manufacturers Association; www.wcmanet.org.
236. WDMA; Window & Door Manufacturers Association; www.wdma.com.
237. WI; Woodwork Institute; (Formerly: WIC; Woodwork Institute of California); www.wicnet.org.
238. WMMPA; Wood Moulding & Millwork Producers Association; (See MMPA).
239. WSRCA; Western States Roofing Contractors Association; www.wsrca.com.

B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

1. DIN; Deutsches Institut für Normung e.V.; www.din.de.
2. IAPMO; International Association of Plumbing and Mechanical Officials; www.iapmo.org.
3. ICC; International Code Council; www.iccsafe.org.
4. ICC-ES; ICC Evaluation Service, LLC; www.icc-es.org.

C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names and Web site addresses are subject to change and are believed to be accurate and 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; http://dodssp.daps.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.
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; http://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; 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. USDJ; Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
18. USP; U.S. Pharmacopeia; www.usp.org.
19. USPS; United States Postal Service; www.usps.com.

D. 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. Names and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

1. ADAAG; Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities; www.access-board.gov.
2. CFR; Code of Federal Regulations; Available from Government Printing Office; www.gpo.gov/fdsys.
3. DOD; Department of Defense; Military Specifications and Standards; Available from Department of Defense Single Stock Point; http://dodssp.daps.dla.mil.
4. DSCC; Defense Supply Center Columbus; (See FS).
5. FED-STD; Federal Standard; (See FS).
6. FS; Federal Specification; Available from Department of Defense Single Stock Point; http://dodssp.daps.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.

7. MILSPEC; Military Specification and Standards; (See DOD).
8. USAB; United States Access Board; www.access-board.gov.
9. USATBCB; U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).

E. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names and Web site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

1. BSC; California Building Standards Commission; www.bsc.ca.gov.
2. Cal/EPA; California Environmental Protection Agency; www.calepa.ca.gov.
3. Cal/OSHA; California Division of Occupational Safety and Health; www.dir.ca.gov/DOSH/dosh1.htm.
4. Cal/Tran; California Department of Transportation; www.dot.ca.gov.
5. CBHF; State of California; Department of Consumer Affairs; Bureau of Electronic Appliance and Repair, Home Furnishings and Thermal Insulation; www.bearhfti.ca.gov.
6. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; www.calregs.com.
7. CDHS; California Department of Health Services; (See CDPH).
8. CDPH; California Department of Public Health; Indoor Air Quality Program; www.cal-iaq.org.
9. CEC; California Energy Commission; www.energy.ca.gov.
10. CPUC; California Public Utilities Commission; www.cpuc.ca.gov.
11. DGS; California Department of General Services; www.dgs.ca.gov.
12. DSA; California Division of State Architect; www.dsa.dgs.ca.gov.
13. OSF; California Office of the State Fire Marshal; www.osfm.fire.ca.gov.
14. OSHPD; California Office of Statewide Health Planning and Development; www.oshpd.ca.gov.
15. SCAQMD; South Coast Air Quality Management District; www.aqmd.gov.
16. TFS; Texas Forest Service; Forest Resource Development and Sustainable Forestry; http://txforestservice.tamu.edu.

PART 2 - PRODUCTS (Not Used)
EXECUTION (Not Used)

END OF SECTION 01 42 00

SECTION 01 50 00 - 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. This Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Sections include the following:

1. Section 01 33 00 "Submittal Procedures" for procedures for submitting copies of implementation and termination schedule and utility reports.
2. Section 01 73 00 "Execution" for progress cleaning requirements.
3. Divisions 02 through 49 for temporary heat, ventilation, and humidity requirements for products in those Sections.

1.3 DEFINITIONS

A. Permanent Enclosure: As determined by Architect, permanent or temporary roofing is complete, insulated, and weathertight; exterior walls are insulated and weathertight; and all openings are closed with permanent construction or substantial temporary closures.

1.4 INFORMATIONAL SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.

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

1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
2. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
3. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, 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.

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.

F. Temporary Utility Reports: Submit reports of tests, inspections, meter readings, and similar procedures performed on temporary utilities.

G. Implementation and Termination Schedule: Within 15 days of date established for submittal of Contractor's Construction Schedule, submit a schedule indicating implementation and termination of each temporary utility.

1.5 QUALITY ASSURANCE

A. Standards: Comply with ANSI A10.6, NECA's "Temporary Electrical Facilities," and NFPA 241.

1. Trade Jurisdictions: Assigned responsibilities for installation and operation of temporary utilities are not intended to interfere with trade regulations and union jurisdictions.
2. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

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

C. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines, and ICC/ANSI A117.1.

1.6 PROJECT CONDITIONS

A. Conditions of Use: The following conditions apply to use of temporary services and facilities by all parties engaged in the Work:

1. Keep temporary services and facilities clean and neat.
2. Relocate temporary services and facilities as required by progress of the Work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide materials suitable for use intended.

B. Pavement: Comply with paving Sections.

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 galvanized steel bases for supporting posts.

D. Wood Enclosure Fence: Plywood, 6 feet high, framed with four 2 by 4 inch rails, with preservative-treated wood posts spaced not more than 8 feet apart.

E. Lumber and Plywood: Comply with requirements in Section 06 10 00 "Rough Carpentry Section 06 10 53 "Miscellaneous Rough Carpentry."

F. 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.

G. Tarpaulins: Fire-resistive labeled with flame-spread rating of 15 or less.

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

I. Water: Potable.

2.2 TEMPORARY FACILITIES

A. Field Offices: Prefabricated or mobile units with lockable entrances, operable windows, and serviceable finishes; heated and air conditioned; on foundations adequate for normal loading.

B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, Commissioning Authority, 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 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no less 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. Coffee machine and supplies.
5. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
6. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.

C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

1. Store combustible materials apart from building.

2.3 EQUIPMENT

A. Fire Extinguishers: Hand carried, portable, UL rated. Provide class and extinguishing agent as indicated or a combination of extinguishers of NFPA-recommended classes for exposures.

1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

B. Self-Contained Toilet Units: Single-occupant units of chemical, aerated recirculation or combustion type; vented; fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.

C. Drinking-Water Fixtures: Drinking-water fountains including paper cup supply.

1. Where power is accessible, provide electric water coolers to maintain dispensed water temperature at 45 to 55 deg F.

D. Power Distribution System Circuits: Where permitted and overhead and exposed for surveillance, wiring circuits, not exceeding 125-V ac, 20-A rating, and lighting circuits may be nonmetallic sheathed cable.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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

required.

1. Locate facilities to limit site disturbance as specified in Section 01 14 00 "Work Restrictions."

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

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Engage appropriate local utility company to install temporary service or connect to existing service. Where utility company provides only part of the service, provide the remainder with matching, compatible materials and equipment. Comply with utility company recommendations.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
2. Provide adequate capacity at each stage of construction. Before temporary utility is available, provide trucked-in services.
3. Obtain easements to bring temporary utilities to Project site where Owner's easements cannot be used for that purpose.

B. Sewers and Drainage: If sewers are available, provide temporary connections to remove effluent that can be discharged lawfully. If sewers are not available or cannot be used, provide drainage ditches, dry wells, stabilization ponds, and similar facilities. If neither sewers nor drainage facilities can be lawfully used for discharge of effluent, provide containers to remove and dispose of effluent off-site in a lawful manner.

1. Filter out excessive soil, construction debris, chemicals, oils, and similar contaminants that might clog sewers or pollute waterways before discharge.
2. Connect temporary sewers to municipal system or private system as directed by authorities having jurisdiction.
3. Maintain temporary sewers and drainage facilities in a clean, sanitary condition. After heavy use, restore normal conditions promptly.
4. Provide temporary filter beds, settlement tanks, separators, and similar devices to purify effluent to levels acceptable to authorities having jurisdiction.

C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction until permanent water service is in use. Sterilize temporary water piping before use.

D. Water Service: Use of Owner's existing water service facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

1. Provide rubber hoses as necessary to serve Project site.
2. As soon as water is required at each level, extend service to form a temporary water- and fire-protection standpipe. Provide distribution piping. Space outlets so water can be reached with a 100 foot hose. Provide one hose at each outlet.
3. Where installations below an outlet might be damaged by spillage or leakage, provide a drip pan of suitable size to minimize water damage. Drain accumulated water promptly from pans.
4. Provide pumps to supply a minimum of 30-psi static pressure at highest point. Equip pumps with surge and storage tanks and automatic controls to supply water uniformly at reasonable pressures.

E. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking-water for use of construction personnel. Comply with regulations and health codes for type, number, location, operation, and maintenance of fixtures and facilities.

1. Disposable Supplies: Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Maintain adequate supply. Provide covered waste containers for disposal of used material.
2. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy. Provide separate facilities for male and female personnel.
3. Wash Facilities: Install wash facilities supplied with potable water at convenient locations for personnel who handle materials that require wash up. Dispose of drainage properly. Supply cleaning compounds appropriate for each type of material handled.

    a. Provide safety showers, eyewash fountains, and similar facilities for convenience, safety, and sanitation of personnel.

4. Drinking-Water Fixtures: Install drinking-water fountains where indicated.

F. Electric Power Service: Provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics during construction period. Include meters, transformers, overload-protected disconnecting means, automatic ground-fault interrupters, and main distribution switchgear.

1. Install electric power service underground, unless overhead service must be used.
2. Install power distribution wiring overhead and rise vertically where least exposed to damage.
3. Connect temporary service to Owner's existing power source, as directed by electric company officials.

G. Electric Power Service: Use of Owner's existing electric power service will be permitted, as long as equipment is maintained in a condition acceptable to 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.
2. Install lighting for Project identification sign.

I. Telephone Service: Provide temporary telephone service throughout construction period in common-use facilities used by all personnel engaged in construction activities. Install separate telephone line for each field office and first-aid station.

1. Provide additional telephone lines for the following:

   a. In a field office with more than two occupants, install a telephone for each additional occupant or pair of occupants.
   b. Provide a separate telephone line for Owner's use.

2. At each telephone, post a list of important telephone numbers.

   a. Police and fire departments.
   b. Ambulance service.
   c. Contractor's home office and emergency after-hours telephone number.
   d. Architect's office.
   e. Engineers' offices.
   f. Owner's office.
   g. Commissioning Authority's office(s).
   h. Principal subcontractors' field and home offices.

3. Provide an answering machine, voice-mail service, or messaging service on the superintendent's telephone.
4. Provide a portable cellular telephone or two-way radio for superintendent's use in making and receiving telephone calls when away from field office.

J. Internet Service: Provide computers with high-speed, broadband connection (examples: Business Class DSL, Multiple T1, Metro Ethernet), including router, equipped with hardware firewall; providing minimum 1Mbps upload and 1 Mbps download speeds for superintendent's use in sending and receiving e-mail.

3.3 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 the Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

3. Janitorial Services: Provide janitorial services on a daily basis for temporary offices, first-aid stations, toilets, wash facilities, lunchrooms, and similar areas.

B. Temporary Use of Permanent Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate to support loads and to withstand exposure to traffic during the construction period. Locate temporary roads and paved areas in same location as permanent roads and paved areas. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.

1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
2. Recondition base after temporary use, including removing contaminated material, regrading, proof rolling, compacting, and testing.
3. Delay installation of the 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 32 12 16 "Asphalt Paving."

C. Traffic Controls: Provide temporary traffic controls at junction of temporary roads with public roads. Include warning signs for public traffic and "STOP" signs for entrance onto public roads. Comply with the 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.

D. Parking: Use designated areas of the Owner's existing parking areas for construction personnel.

E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction and in applicable Division 31 Sections for temporary drainage and dewatering facilities and operations not directly associated with construction activities included in individual Sections. Where feasible, use same facilities. 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 property nor endanger permanent Work or temporary facilities.
2. Before connection and operation of permanent drainage piping system, provide temporary drainage where roofing or similar waterproof deck construction is completed.
3. Remove snow and ice as required to minimize accumulations.

F. Project Signs: Prepare Project signs as indicated. Do not permit installation of unauthorized signs.

1. Identification Signs: Provide Project identification signs as indicated on

Drawings. Engage an experienced sign painter to apply graphics for Project identification signs. Comply with details indicated.

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.

G. Waste Disposal Facilities: Comply with requirements specified in Section 01 74 19 "Construction Waste Management and Disposal."

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 01 73 00 "Execution."

1. If required by authorities having jurisdiction, provide separate containers, clearly labeled, for each type of waste material to be deposited.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

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

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that 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 01 14 00 "Work Restrictions."

C. Temporary Erosion and Sedimentation Control: Comply with requirements of 2003 EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent and requirements specified in Section 31 10 00 "Site Clearing."

D. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to requirements of 2003 EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.

1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant- protection zones.
2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
3. Clean, repair, and restore adjoining properties and roads affected by

erosion and sedimentation from Project site during the course of Project.

4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

E. 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.

F. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

G. Tree and Plant Protection: Comply with requirements in Section 01 56 39 "Temporary Tree and Plant Protection."

H. Pest Control: Before deep foundation work has been completed, retain a local exterminator or pest-control company to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests. Engage this pest-control service 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.

I. Site Enclosure Fence: Before construction operations begin, install site enclosure fence with lockable entrance gates. Install in a manner that will prevent people, dogs, and other 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. Provide gates in sizes and at locations necessary to accommodate delivery vehicles and other construction operations.
3. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.

J. Security Enclosure and Lockup: Install substantial 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.

K. Barricades, Warning Signs, and Lights: Comply with authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting. Paint with appropriate colors and graphics to inform personnel and public of possible hazard.

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

M. Temporary Fire Protection: Until fire-protection needs are supplied by permanent facilities, 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 area.
2. Provide fire extinguishers, installed on walls on mounting brackets, visible and accessible from space being served, with sign mounted above.

    a. Field Offices: Class A stored-pressure water-type extinguishers.
    b. Other Locations: Class ABC dry-chemical extinguishers or a combination of extinguishers of NFPA-recommended classes for exposures.
    c. Locate fire extinguishers where convenient and effective for their intended purpose; provide not less than one extinguisher on each floor at or near each usable stairwell.

3. Store combustible materials in containers in fire-safe locations.
4. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for firefighting.
5. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition.
6. Permanent Fire Protection: At earliest feasible date in each area of Project, complete installation of permanent fire-protection facility, including connected services, and place into operation and use. Instruct key personnel on use of facilities. Protect fire protection system from damage due to construction activities and environmental conditions.
7. Develop and supervise an overall fire-prevention and first-aid fire-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.
8. Provide hoses for fire protection of sufficient length to reach construction areas. 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.
9. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.5 MOISTURE AND MOLD CONTROL

A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.

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.

C. Keep deck openings covered or dammed.

D. 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.

E. 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] <Insert time period> 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.

3.6 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.

Protect from damage caused by freezing temperatures and similar elements.

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.
2. Prevent water-filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.

C. Temporary Facility Changeover: Except for using permanent fire protection as soon as available, 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 the property of Contractor. Owner reserves right to take possession of Project identification signs.
2. Remove temporary paving not intended for or acceptable for integration into permanent paving. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. At Substantial Completion, repair, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements in Section 01 77 00 "Closeout Procedures."

END OF SECTION 01 50 00

SECTION 015639 - TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of this Section Includes: Preserve and protect existing trees, shrubs and other plant materials to remain, including protecting plants and trees on adjoining properties.

1.2 RELATED DOCUMENTS

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

1. Section 015000 "Temporary Facilities and Controls"
2. Section 311000 “Site Clearing”

1.3 DEFINITIONS

A. Caliper: Diameter of a trunk measured by a diameter tape at a height 6 inches above the ground for trees up to and including 4-inch size at this height and as measured at a height of 12 inches above the ground for trees larger than 4-inch size.
B. Diameter at breast height (DBH): diameter of a trunk as measured by a diameter tape at a height 4.5 feet from the ground surface.
C. Canopy Radius: Approximate average distance from the stem to the limits of the drip line, or end of branches.
D. Critical Root Zone (CRZ): The minimum volume of roots necessary for the maintenance of tree health and stability, typically determined by measuring the tree diameter 4.5 ft. above grade and multiplying by 12 in., a minimum radius of 10’ from the trunk, or at the tree’s dripline, whichever is farthest from the trunk, or as otherwise indicated on the drawings, or established in the field. CRZ will be determined/established on a case-by-case basis by the arborist and approval by the landscape architect.
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. Stems: Number of trunks or shoots that contribute significantly to the canopy.
G. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction. The Tree-Protection Zone is defined by the CRZ of individual trees.

1.4 PREINSTALLATION MEETINGS

A. On Site Preinstallation Meeting: Conduct meeting at Project site with representatives for the architect, arborist, contractor, and client present.

1. Contractor shall review and identify with Landscape Architect the limits of work and extent of plant and tree materials to be protected.

2. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:
    a. Tree-service firm's personnel and equipment needed to make progress and avoid delays.
    b. Arborist's responsibilities.
    c. Quality-control program.
    d. Coordination of Work and equipment movement with the locations of protection zones.
    e. Trenching by hand or with air spade within protection zones.
    f. Field quality control.

1.5 ACTION SUBMITTALS

A. Tree-Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.

1. Species and size of tree.
2. Location on site plan. Include unique identifier for each.
3. Reason for pruning.
4. Description of pruning to be performed.
5. Description of maintenance following pruning.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Statements: For tree service firm.
B. Certification: From ISA certified arborist, certifying that trees indicated to remain have been protected during construction in accordance with recognized standards and that trees were promptly and properly treated and repaired when damaged.
C. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.
D. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.

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 plants designated to remain.

E. Quality-control program.

1.7 QUALITY ASSURANCE

A. Arborist Qualifications: Certified Arborist as certified by ISA.
B. Quality-Control Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work without damaging trees and plantings. Include dimensioned diagrams for placement of protection-zone fencing and signage, the arborist's and tree-service firm's responsibilities, instructions given to workers on the use and care of protection zones, and enforcement of requirements for protection zones.

1.8 FIELD CONDITIONS

A. No development, fill, excavation, construction materials, equipment staging, or traffic shall be allowed in the critical root zone of the trees that are to be retained. Practices prohibited within the protection zones include:

1. Storage of construction materials, debris, or excavated material.
2. Moving or 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.

B. If any construction work needs to be performed inside either the tree drip line, critical root zone, and/or the inner critical root zone, the project arborist will be on site to supervise the work.

C. Do not direct vehicle or equipment exhaust toward protection zones.

D. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Backfill Soil: Planting soil of suitable moisture content and granular texture for placing around tree; free of stones, roots, plants, sod, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth.

B. Protection-Zone Fencing: Subject to approval by the Owners Representative, fencing fixed in position and meeting the following requirements:

1. Protection-Zone Fencing: High density polyethylene fencing with 3.5" x 1.5" openings and steel posts installed 8' O.C. on pier blocks.
   a. Height: 72 inches.
   b. Color: Orange

2. Gates: Double- swing access gates matching material and appearance of fencing, to allow for maintenance activities within protection zones; leaf width 36 inches.

C. Protection-Zone Signage: Signs shall be posted visibly on all sides of the fenced areas.

1. Shop-fabricated, rigid plastic or metal sheet with attachment holes pre-punched and reinforced; legibly printed with nonfading lettering and as follows:
   a. Sign placard: Twelve inches tall by 18 inches long, laminated in plastic.
   b. Text: "Tree Protection Area"
   c. Lettering: 4-inch- high minimum, black characters on white background.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
B. Prepare written report, endorsed by arborist, listing conditions detrimental to tree and plant protection.

3.2 PREPARATION

A. During the on-site pre-installation meeting, locate and clearly identify trees, shrubs, and other vegetation to remain. Tie a 1-inch blue vinyl tape around each tree trunk at 54 inches above the ground.
B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.

    1. In addition to the above minimum tree protection measures, support tree protection efforts by employing, as appropriate, the following best management practices for maintaining the health of the tree:
        a. Prune visible deadwood on trees to be protected or relocated.
        b. Provide a layer of arborist mulch 3 inches deep in the CRZ of retained trees.
        c. Ensure one inch of irrigation or rainfall per week during and immediately after construction and from early May through September until reliable rainfall occurs in the fall.

3.3 TREE PROTECTION

A. Prior to any land disturbance, place temporary construction fence around the tree protection zone to be preserved. If a cluster of trees is proposed for retention, the barrier shall be placed around the edge formed by the CRZ of the trees to be retained. If work is to occur within CRZs, fencing on Tree Retention Plan will indicate acceptable location and additional alternative protection methods employed (trunk wrap, CRZ matting, etc).
B. Place fencing around each tree or group of trees to be retained.

    1. Fence to be five feet outside Tree Protection Zone of the tree or group of trees or as noted on plans.

C. Tree protection shall remain in place for the duration of the permit unless earlier removal is addressed through construction sequencing on approved plans.
D. If any construction work must be performed inside either the tree drip line, critical root zone, and/or the inner critical root zone, the project arborist shall be on site to supervise the work.

    1. Install temporary root-protection matting over mulch to the extent indicated by the Tree Retention Plan.

2. When excavation must occur within or near the critical root zone, any found roots three inches or greater in diameter will be cleanly cut to the edge of the trench to avoid ripping of the root. Arborist must evaluate roots prior to cutting any roots greater than 1 inch in diameter.

3.4 PROTECTION ZONES

A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people from easily entering protected areas except by entrance gates. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.

1. Protection Zone Fencing: Install to comply with manufacturer's written instructions.
2. Posts: Set posts using pier blocks only. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Architect.
   a. Avoid driving posts of stakes into major roots.
3. Access Gates: Install as required; adjust 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. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a manner approved by Architect. Install one sign spaced approximately every 50 ft. on protection-zone fencing, but no fewer than four signs with each facing a different direction. 4-inch minimum text size, sign laminated in plastic.

C. Maintain protection zones free of weeds and trash.

D. Maintain protection-zone fencing and signage in good condition as acceptable to Architect and remove when construction operations are complete and equipment has been removed from the site.

1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.
2. Temporary access is permitted subject to preapproval in writing by arborist if a root buffer effective against soil compaction is constructed as directed by arborist. Maintain root buffer so long as access is permitted.

3.5 EXCAVATION

A. General: Excavate at edge of protection zones and for trenches indicated within protection zones in accordance with requirements in Section 312000 "Earthwork" unless otherwise indicated.

B. Trenching or Excavating within Protection Zones: Where utility trenches are required within protection zones, excavate under or around tree roots by hand or with air spade, or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of

utilities. Cut roots as required for root pruning. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots.

C. Redirect roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots approximately 3 inches back from new construction and as required for root pruning.

D. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

3.6 ROOT PRUNING

A. Prune tree roots that are affected by temporary and permanent construction. Prune roots as follows:

1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots. Any root pruning must be supervised by an arborist.
2. Cut Ends: Do not paint cut root ends.
3. Temporarily support and protect roots from damage until they are permanently covered with soil.
4. Cover exposed roots with burlap and water regularly.
5. Backfill as soon as possible in accordance with requirements in Section 312000 "Earthwork."

B. Root Pruning at Edge of Protection Zone: Prune tree roots 12 inches outside of the protection zone by cleanly cutting all roots to the depth of the required excavation.

C. Root Pruning within Protection Zone: Clear and excavate by hand or with air spade to the depth of the required excavation to minimize damage to tree root systems. If excavating by hand, use narrow-tine spading forks to comb soil to expose roots. Cleanly cut roots as close to excavation as possible.

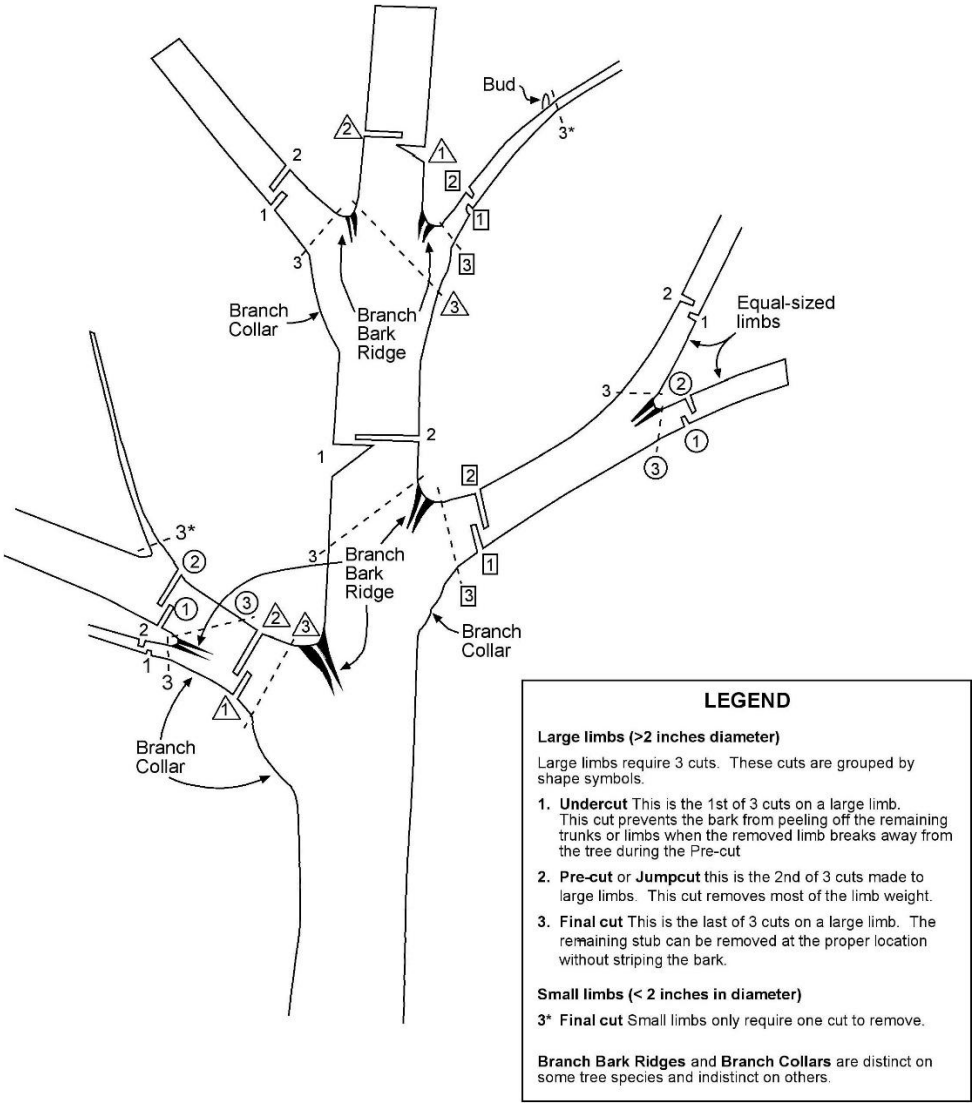
3.7 CROWN PRUNING

A. Prune branches that are affected by temporary and permanent construction. Raise Prune branches as directed by arborist.

1. Prune to remove only injured, broken, dying, or dead branches unless otherwise indicated. Do not prune for shape unless otherwise indicated.
2. Do not remove or reduce living branches to compensate for root loss caused by damaging or cutting root system.
3. Pruning cuts should be made back to an appropriate branch or trunk. Do not stub cut branches or top a tree.
4. Do not remove more than 25% of the overall canopy.
5. Pruning Standards: Prune trees in accordance with ANSI A300 (Part 1).

B. Unless otherwise directed by arborist and acceptable to Architect, do not cut tree leaders.

C. Cut branches with sharp pruning instruments; do not break or chop.
D. Do not paint or apply sealants to wounds.
E. Provide subsequent maintenance pruning during Contract period as recommended by arborist.
F. Chip removed branches and stockpile in areas approved by Architect.



3.8 REGRADING

A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, construct rock walls around the tree, equal to the dripline. Maintain existing grades within the protection zone.
B. Lowering Grade within Protection Zone: Where new finish grade is indicated below existing grade around trees, slope grade away from trees as recommended by arborist unless otherwise indicated.

1. Root Pruning: Prune tree roots exposed by lowering the grade. Do not cut main lateral roots or taproots; cut only smaller roots. Cut roots as required for root pruning.

C. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

1. If additional grade is required within the CRZ, increase grade by a maximum of 3".

3.9 FIELD QUALITY CONTROL

A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

3.10 REPAIR

A. Repair trees, shrubs, and other vegetation indicated to remain or to be relocated that are damaged by construction operations, in a manner approved by Landscape Architect.

1. Submit details of proposed pruning and repairs.
2. Perform repairs of damaged trunks, branches, and roots within 24 hours in accordance with arborist's written instructions.
3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.

3.11 REPLACEMENT

A. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Landscape Architect.
B. Remove and replace trees indicated to remain 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 Landscape Architect determines are incapable of restoring to normal growth pattern.
C. Trees: Provide new trees of same size and species,
D. Shrubs: Replace with 5 gal of same species.
E. Plant and maintain new trees and plants as specified in Section 329300 "Plants."
F. Decompaction: Decompact soils by hand as required by the Owners Representative.

END OF SECTION

SECTION 01 57 23 - TEMPORARY STORMWATER POLLUTION CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. Work Includes: Stormwater pollution prevention measures during construction activities.
   1. The Contractor shall continue to comply with the administrative requirements related to the SWPPP during and following completion of construction.
   2. Any and all fines resulting from the negligence of the Contractor to properly implement the measures specified in the SWPPP and/or by the Qualified SWPPP Practitioner shall be paid for by the Contractor.

1.2 REFERENCES

A. *State of California Construction General Permit 2022-0057-DWQ,* dated September 08, 2022.

B. *Waste Discharge Requirements for Storm Water (Wet Weather) and Non-Storm Water (Dry Weather) Discharges from the Municipal Separate Storm Sewer Systems Within the Ventura County Watershed Protection District, County of Ventura and the Incorporated Cities Therein, Order R4-2021-0105, NPDES Permit No. CAS004004,* dated July 23, 2021.

C. *Storm Water Pollution Prevention Plan* dated 11/4/2025 (or as most recently revised) prepared by Encompass Consultant Group.

1.3 PROJECT CONDITIONS

A. This project is subject to the State General Construction National Pollutant Discharge Elimination System (NPDES) Permit. Therefore, the contractor shall comply with all aspects of the State General Construction Permit including preparation and implementation of the required Storm Water Pollution Prevention Plan and related Sampling & Analysis section.

PART 2 – PRODUCTS

NOT USED.

PART 3 – EXECUTION

3.1 STORMWATER POLLUTION PREVENTION MEASURES

A. All stormwater pollution prevention measures shall be in accordance with the SWPPP. In the event circumstances during the course of construction require changes to the original SWPPP, a revised plan shall be promptly submitted to the District's Representative in each instance for approval by the Qualified SWPPP Developer. No responsibility shall accrue to the Owner as a result of the plan or as a result of knowledge of the plan. All work installed by the contractor in connection with the SWPPP but not specified to become a permanent part of the project shall be removed and the site restored to its original condition prior to completion of construction or when directed by the District's Representative.

END OF SECTION

SECTION 01 60 00 - 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 the following administrative and procedural requirements: selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

B. Related Sections:

1. Section 01 25 00 "Substitution Procedures" for requests for substitutions.
2. Section 01 42 00 "References" for applicable industry standards for products specified.
3. Section 01 77 00 "Closeout Procedures" for submitting warranties for contract closeout.
4. Divisions 03 through 49 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.3 DEFINITIONS

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

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation, shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.

3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, 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.

B. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," 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 for purposes of evaluating comparable products of other named manufacturers.

C. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.

D. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

1.4 ACTION SUBMITTALS

A. Comparable Product Requests: 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. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

    a. Form of Approval: As specified in Section 01 33 00 "Submittal Procedures."
    b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 01 33 00 "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, product selected shall be 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.

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.

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
5. Store products to allow for inspection and measurement of quantity or counting of units.
6. Store materials in a manner that will not endanger Project structure.
7. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
8. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
9. Protect stored products from damage and liquids from freezing.
10. 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. Submit a draft for approval before final execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: Forms are included with the Specifications. Prepare a written document using appropriate form properly executed.
3. Refer to Divisions 03 through 49 Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements Section 01 77 00 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

A. Components, materials, or parts required to be supplied in quantity within a Section shall be of the same manufacture, shall be interchangeable, and shall be the same with regard to function, texture, pattern, and color.

B. Except for building equipment in service areas, no manufacturers' labels or name plates shall be visible on any component, unless required by local authorities having jurisdiction.

2.2 PRODUCT SELECTION PROCEDURES

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

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: Unless custom products or nonstandard options are specified, provide products of both quality and type that have been used successfully in similar situations on equal quality 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 "match sample," sample to be matched is Architect's.
5. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.

B. Product Selection Procedures: Procedures for product selection include the following:

1. 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.
2. 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.
3. Products:

    a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.

4. Manufacturers:

    a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.

5. Basis-of-Design Products: Where Specification paragraphs or subparagraphs titled "Basis-of-Design Products" are included and also introduce or refer to a list of manufacturers' names, provide either the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
6. Visual Matching Specification: Where Specifications require matching an established Sample, provide a product (and manufacturer) that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches satisfactorily.

    a. If no product available within specified category matches satisfactorily and complies with other specified requirements, comply with requirements in Section 01 25 00 "Substitution Procedures" for proposal of product.

7. Visual Selection Specification:

    a. Standard Range: Where Specifications include the phrase "as selected by Architect from manufacturer's standard range" or similar phrase, Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that does not include premium items.

8. Allowances: Refer to individual Specification Sections and "Allowance" provisions in Division 01 for allowances that control product selection and for procedures required for processing such selections.

PART 3 - EXECUTION (Not Used)
END OF SECTION 01 60 00

SECTION 01 73 00 - 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. This Section includes general 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 Sections include the following:

1. Section 01 31 00 "Project Management and Coordination" for procedures for coordinating field engineering with other construction activities.
2. Section 01 33 00 "Submittal Procedures" for submitting surveys.
3. Section 01 77 00 "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 07 84 13 "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.

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

1.5 QUALITY ASSURANCE

A. 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.

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.
2. Provide color and finish at exposed concrete surfaces at curbs and sidewalks to match existing conditions, where removal of existing is required to install new underground work.

PART 3 - EXECUTION

3.1 EXAMINATION

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

1. Before construction, verify the location and points of connection of utility services.
2. Provide potholing at location identified by Architect for utilities conflicts and existing utility verification. Provide potholing timely to ensure early coordination of underground work affecting utilities in area identified.

B. 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 and other construction affecting the Work.

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

C. 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.

D. 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.

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

3.2 PREPARATION

A. 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.

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

C. 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 interpretation to Architect according to Section 01 26 13 "Request for Interpretation."

3.3 CONSTRUCTION LAYOUT

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

B. General: Engage a land surveyor 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 [and Construction Manager] 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 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 on the need to relocate permanent benchmarks or control points to the Architect [and Construction Manager] 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] <Insert number> permanent benchmarks on Project site, referenced to data established by survey control points. Comply with the 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.

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. Where indicated to remain exposed, arrange overhead systems in an orderly manner.
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 produces 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. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

K. Protect adjacent property and adjoining work, including sealant bond surfaces, from spillage or blow-over of coatings, paints, sprayed fire-resistive material, and other spray-applied products. Cover adjoining and nearby surfaces, including live plants and grass, if there is possibility of spray-applied products being deposited on surfaces.

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. Temporary Support: Provide temporary support of work to be cut.

C. 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.

D. 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 01 14 00 "Work Restrictions."

E. 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: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill. Avoid cutting steel reinforcement.

    a. Locate steel reinforcement using Ground Penetrating Radar or Ferroscan prior to cutting or drilling reinforced concrete and masonry. If existing steel reinforcement is in the proposed cut or hole location, contact Architect before proceeding with the Work.

4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

F. 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.

G. 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 forces.

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction forces.

3.8 PROGRESS CLEANING

A. General: Clean the Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
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: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted. Comply with Section 01 74 19 "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 01 91 13 "General Commissioning Requirements."

B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

C. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.

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: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Section 01 40 00 "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. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 01 73 00

SECTION 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 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.

B. Related Requirements:

1. Section 02 41 19 "Selective Demolition" for disposition of waste resulting from partial demolition of buildings, structures, and site improvements, and for disposition of hazardous waste.
2. Section 31 10 00 "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

1.2 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.3 PERFORMANCE REQUIREMENTS

A. General: Achieve end-of-Project rates for salvage/recycling of 50 percent by weight of total non-hazardous solid waste generated by the Work. 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.

1.4 ACTION SUBMITTALS

A. Waste Management Plan: Submit plan within 7 days of date established for commencement of the Work.

1.5 INFORMATIONAL SUBMITTALS

A. 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.

B. 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.

C. 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.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Waste Management Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:

1. Review and discuss the 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.

1.7 WASTE MANAGEMENT PLAN

A. General: Develop a waste management plan according to ASTM E 1609 and requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Indicate quantities by weight or volume but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of site-clearing and construction waste generated by the Work. . Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.

5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

PART 2 - PRODUCTS

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 01 50 00 "Temporary Facilities and Controls."

B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan.

C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.

1. Distribute waste management plan to everyone concerned within three days of submittal return.
2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
2. Comply with Section 01 50 00 "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 storage area designated by Owner.
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. 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.

C. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical 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. Asphalt Paving: Grind asphalt to a maximum 4-inch size.

1. Crush asphaltic concrete paving and screen to comply with requirements in Section 31 20 00 "Earth Moving" for use as general fill.

B. Asphalt Paving: Break up and transport paving to asphalt-recycling facility.

C. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.

1. Pulverize concrete to a maximum 1-1/2-inch size.
2. Crush concrete and screen to comply with requirements in Section 31 20 00 "Earth Moving" for use as satisfactory soil for fill or subbase.

D. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.

1. Pulverize masonry to maximum 4-inch size.

    a. Crush masonry and screen to comply with requirements in Section 31 20 00 "Earth Moving" for use as satisfactory soil for fill or subbase.
    b. Crush masonry and screen to comply with requirements in Section 32 93 00 "Plants" for use as mineral mulch.

E. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.

F. 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.

G. Asphalt Shingle Roofing: Separate organic and glass-fiber asphalt shingles and felts. Remove and dispose of nails, staples, and accessories.

H. Carpet Tile: Remove debris, trash, and adhesive.

I. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components 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 the 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 32 93 00 "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 32 93 00 "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 and dispose of at designated spoil areas on Owner's property.

END OF SECTION 01 74 19

SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for contract closeout.

1.2 ACTION SUBMITTALS

A. Product Data: For cleaning agents.

B. Contractor's List of Incomplete Items (Punch List): Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.3 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Project Record Documents:

1. Record Drawings.
2. Record Specifications.
3. Record product data.
4. Miscellaneous record submittals.

D. Operation and maintenance manual(s).

E. Warranties.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.5 SUBSTANTIAL COMPLETION PROCEDURES

A. Submittals Prior to Substantial Completion: Complete the following a minimum of 5 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Prepare and submit a list of incomplete items (punch list), indicating the value of items on the list, and reasons why the Work is not complete.
2. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, final certifications, and similar documents.
3. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
4. Prepare and submit Project Record Documents, operation and maintenance manuals, and similar final record information.
5. 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.

    a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.

6. Submit test/adjust/balance records.
7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

B. Procedures Prior to Substantial Completion: Complete the following prior to requesting inspection 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 01 79 00 "Demonstration and Training."

6. Advise Owner of changeover in utility services.
7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
8. Terminate and remove temporary facilities from Project sire, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements.
10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.

C. Inspection: Submit a written request for inspection for Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect and Construction Manager] will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection 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. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

1.6 FINAL COMPLETION PROCEDURES

A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:

1. Submit a final Application for Payment.
2. Submit copy of Contractor's original Substantial Completion inspection list with Architect's annotations of items to be completed or corrected (punch list), endorsed and dated by Architect. Copy shall be certified by Contractor and state that each item has been completed or otherwise resolved for acceptance.

B. Inspection: Submit a written request for final inspection for acceptance a minimum of 5 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect[and Construction Manager] will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.7 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Preparation: 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.

1. Organize list of spaces in sequential order[, 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.

B. Submit list of incomplete items in MS Excel electronic file and three paper copies. Architect will return annotated electronic file.

1.8 PROJECT RECORD DOCUMENTS

A. General: Do not use Project Record Documents for construction purposes. Protect Project Record Documents from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

B. Record Drawings: Maintain and submit one set of blue- or black-line white prints of Contract Drawings and Shop Drawings.

1. 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 an Installer, subcontractor, or similar entity, to prepare the marked-up record prints.

a. Give particular attention to information on concealed elements that cannot be readily identified and recorded later, and the locations of those items that need to be located for servicing.
b. Accurately record information in a readily understandable drawing technique.
c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
d. Mark record prints completely and accurately.
e. Mark important additional information that was either shown schematically or omitted from original Drawings.
f. Note Change Order numbers, alternate numbers, and similar identification where applicable.

C. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications. Clearly mark copy 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. Note related Change Orders, Record Drawings, and Product Data, where applicable.

D. Record Product Data: Submit one copy of each Product Data submittal. Mark one set to indicate the actual product installation where installation varies substantially from that indicated in Product Data.

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 Drawings, where applicable.

E. Miscellaneous Record Submittals: Assemble miscellaneous records required by other Specification Sections such as tests and inspections, and inspections by authorities having jurisdiction. Bind or file miscellaneous records and identify each, ready for continued use and reference.

1.9 OPERATION AND MAINTENANCE MANUALS

A. Assemble a complete set of operation and maintenance data indicating the operation and maintenance of each system, subsystem, and piece of equipment not part of a system. Include operation and maintenance data required in individual Specification Sections and as follows:

1. Operation Data:

    a. Emergency instructions and procedures.
    b. System, subsystem, and equipment descriptions, including operating standards.
    c. Operating procedures, including startup, shutdown, seasonal, and weekend operations.
    d. Description of controls and sequence of operations.
    e. Piping diagrams.
    f. Noise and vibration adjustments.
    g. Effective energy utilization.

2. Maintenance Data:

    a. Manufacturer's information, including list of spare parts.
    b. Name, address, and telephone number of Installer or supplier.
    c. Maintenance procedures.
    d. Maintenance and service schedules for preventive and routine maintenance.
    e. Maintenance record forms.
    f. Sources of spare parts and maintenance materials.
    g. Copies of maintenance service agreements.
    h. Copies of warranties and bonds.
    i. Control sequence.
    j. Fuels, lubricants, tool, and other related items.
    k. Identification systems.

B. Organize operation and maintenance manuals into suitable sets of manageable size. Bind and index data in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, with a pocket inside the covers to receive folded oversized sheets. Identify each binder on front and spine with the printed title "OPERATION AND MAINTENANCE MANUAL," Project name, and subject matter of contents.

1.10 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.

C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

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.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to the condition expected in an average commercial building cleaning and maintenance program. Comply with the manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:

    a. 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 not planted, mulched, or paved to a smooth, even-textured surface.
    d. Remove tools, construction equipment, machinery, and surplus material from Project site.
    e. Clean exposed hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Restore reflective surfaces to their original condition.
    f. Remove debris and surface dust from limited access spaces, including plenums, shafts, and similar spaces.
    g. Sweep concrete floors broom clean in unoccupied spaces.
    h. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo 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. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
    j. Remove labels that are not meant to be permanent.
    k. Wipe surfaces of mechanical and electrical 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.
    o. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in lighting fixtures to comply with requirements for new fixtures.
    p. Leave Project clean and ready for occupancy.

C. Pest Control: Comply with pest control requirements in Section 01 50 00 "Temporary Facilities and Controls." Prepare written report.

D. Construction Waste Disposal: Comply with waste disposal requirements in Section 01 74 19 "Construction Waste Management and Disposal."

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations before requesting inspection 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.
    b. Do not paint over labels for fire resistive joints.

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 01 77 00

SECTION 01 78 39 - 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 project record documents, including the following:

1. Record Drawings.
2. Record Specifications.
3. Record Product Data.
4. Miscellaneous record submittals.

B. Related Requirements:

1. Section 01 73 00 "Execution" for final property survey.
2. Section 01 77 00 "Closeout Procedures" for general closeout procedures.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit one set(s) of marked-up record prints.
2. Number of Copies: Submit copies of record Drawings as follows:

a. Initial Submittal:

1) Submit one paper-copy set(s) of marked-up record prints.
2) Submit PDF electronic files of scanned record prints and one of file prints.
3) Submit record digital data files and one set(s) of plots.
4) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.

b. Final Submittal:

1) Submit three paper-copy set(s) of marked-up record prints.
2) Submit PDF electronic files of scanned record prints and set(s) of prints.
3) Print each drawing, whether or not changes and additional information were recorded.

B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.

C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.

1. Where record Product Data is required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

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 a 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 RECORD DRAWINGS

A. Record Prints: 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 the individual or entity is an Installer, subcontractor, or similar entity, to provide information for the 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 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 Construction Change Directive.
k. Changes made following Architect's written orders.
l. Details not on the original Contract Drawings.
m. Field records for variable and concealed conditions.
n. Record information on the Work that is shown only schematically.

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.

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: Same digital data software program, version, and operating system as the original Contract Drawings.
2. Format: Annotated PDF electronic file.
3. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
4. Refer instances of uncertainty to Architect for resolution.
5. Architect will furnish the Contractor with one set of digital data files of the Contract Drawings for use in recording information.

a. See Section 01 31 00 "Project Management and Coordination" for requirements related to use of the Architect's digital data files.

b. Architect will provide data file layer information. Record markups in separate layers.

C. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file.
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:

a. Project name.
b. Date.
c. Designation "PROJECT RECORD DRAWINGS."
d. Name of Architect.
e. Name of Contractor.

1.5 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. 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 the 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 RECORD PRODUCT DATA

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.

B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturers' written instructions for installation.
3. Note related to Change Orders, [record Specifications], and record Drawings where applicable.

C. 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. 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 [and Construction Manager's] reference during normal working hours.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 78 39

SECTION 01 79 00 - 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 QUALITY ASSURANCE

A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 01 40 00 "Quality Requirements," experienced in operation and maintenance procedures and training.

B. Preinstruction Conference: Conduct a conference at Project site to comply with requirements in Section 01 31 00 "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 the instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
3. Review the 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.

1.3 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting the 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 the content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit the instruction program until operation and maintenance data have been reviewed and approved by the Architect.

1.4 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 01 77 00 "Closeout Procedures."

B. Set up instructional equipment at instruction location.

1.5 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.

1.6 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.

1. At beginning of each training module, record each chart containing learning objective and lesson outline.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 79 00

SECTION 018113.19 - BUY CLEAN CALIFORNIA ACT (BCCA)

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general reference of Buy Clean California Act (BCCA) limits on global warming potential (GWP) of frequently used construction materials with typically high global warming potential. The project is subject to compliance with Residential measures of the California Green Building Code which does not require compliance with the limits established by the BCCA.

1.2 Global Warming Potential (GWP) Limits:

A. Table 1: GWP limits for eligible materials

Eligible material	**Maximum acceptable GWP limit[1]for unfabricated product (cradle-to-gate)[2]**	**Maximum acceptable GWP limit[1]for fabricated product (A1 module only)[3]**
Hot-rolled structural steel sections	1,010 kg CO_2eq.[4]or 1.01E+03 kg CO_2eq. for one metric ton of structural steel.	1,080 kg CO_2eq. or 1.08E+03 kg CO_2eq. for one metric ton of structural steel.
Hollow structural sections	1,710 kg CO_2eq. or 1.71E+03 kg CO_2eq. for one metric ton of structural steel.	1,830 kg CO_2eq or 1.83E+03 kg CO_2eq for one metric ton of structural steel.
Steel plate	1,490 kg CO_2eq. or 1.49E+03 kg CO_2eq. for one metric ton of structural steel.	1,590 kg CO_2eq. or 1.59E+03 kg CO_2eq. for one metric ton of structural steel.
Concrete reinforcing steel	890 kg CO_2eq. or 8.90E+02 kg CO_2eq. for one metric ton of bar.	920 kg CO_2eq. or 9.20E+02 kg CO_2eq. for one metric ton of bar.
Flat glass	1,430 kg CO_2eq. or 1.43E+03 kg CO_2eq. for one metric ton of glass.	N/A
Light-density mineral wool board insulation	3.33 kg CO_2eq. for 1 $m^2$of insulation at R_{SI}=1.[5]	N/A
Heavy-density mineral wool board insulation	8.16 kg CO_2eq. for 1 $m^2$of insulation at R_{SI}=1	N/A

[1] GWP limit is based on a 100-year lifetime impact and excludes biogenic carbon.

[2] Use this column to determine compliance when an EPD declares unfabricated product GWP. Compare manufacturer cradle-to-gate GWP (i.e., the sum of information modules A1-A3) to the limit.

[3] Use this column to determine compliance when an EPD declares fabricated product GWP (compare GWP from information module A1 to the limit). These limits are derived from the unfabricated product GWP and account for the waste in the fabrication process.

[4] Kilogram carbon dioxide equivalent.

[5] Thermal resistance (R_{SI}) with a value of 1m^2K/W (square meters x degrees Kelvin per watt).

DGS leveraged current industrywide EPDs to determine the industry average and set the final limits above.

B. Table 2: Description of eligible materials

Eligible material	Description
Structural steel	**Hot-rolled sections** consisting of wide flange beams (W-shape and HP-shape used in structural applications), standard beams (S-shape), misc. beams (M-shape), channels, angles, and tees. **Hollow structural sections** with round, square, or rectangular cross-section. **Plate material.**
Concrete reinforcing steel	ASTM A615/A615M ASTM A706/A706M ASTM A767/A767M ASTM A775/A775M
Flat glass	**Float or rolled glass** that is clear or tinted either installed by itself or as a part of a window assembly. **Processed glass** (e.g., tempered, coated, or laminated) is out of scope of the BCCA.
Mineral wool board insulation	Board insulation made of **rock or slag** in **light**- and **heavy-density** types. **Light-density:** 2.5 lbs/ft^3 – 4.3 lbs/ft^3 **Heavy-density:** 4.4 lbs/ft^3 – 8 lbs/ft^3 lbs/ft^3 is pounds per cubic foot.

1.3 Informational Submittals:

A. Environmental Product Declarations: An EPD must meet certain requirements before reviewer can determine material compliance.

B. An EPD must be:

1. A facility-specific manufacturer declaration
2. Independently verified in accordance with ISO 14025 (Type III environmental declarations – Principles and procedures)
3. Developed according to the guidelines of the applicable Product Category Rule (PCR) acceptable to the awarding authority.
4. Valid at the time of material installation
5. Representing an eligible material (as described in FAQ Section 2.0, Table 2)

C. An EPD **must not be:**

1. An industrywide/industry-average product declaration
2. A fabricator's product declaration
3. A companywide declaration that doesn't report the GWP of its manufacturing facilities separately

1.4 Definitions:

A. Environmental Product Declaration, or (EPD): An EPD is an independently verified and registered document that reports a product's environmental impact over its life cycle.

B. Fabricator: A facility that takes material from a manufacturer or producer and modifies it through fabrication techniques such as bending, welding, cutting, finishing.

C. Facility-specific manufacturer EPD: A product EPD in which the environmental impacts are disclosed for a single manufacturer and single manufacturing facility. A companywide EPD may also be considered facility-specific if it discloses the GWP for each manufacturing facility separately.

D. Manufacturer: With respect to the BCCA, a manufacturer is the entity that produces the basic construction material that typically requires additional processing by fabricators before use in a construction project. Used interchangeably by the BCCA with the term producer.

E. Producer: Used interchangeably by the BCCA with the term manufacturer.

F. Product Category Rule (PCR): A PCR is a set of rules, requirements and guidelines used to develop an EPD for a product group.

1. Reference PCRs for eligible materials: The PCRs listed below should be used to develop EPDs for a wide variety of products within the eligible material category (i.e., structural steel, concrete reinforcing steel, flat glass, and mineral wool board insulation). Please refer to FAQ Section 2.0 (Table 2) above to understand exactly which products need to comply with the initial rollout of the BCCA.
2. Structural steel and concrete reinforcing steel
    a. Valid through: April 3, 2030
    b. Version: 3.0
    c. Program operator: Smart EPD
3. Flat glass
    a. NGA PCR for Flat Glass: UN CPC 3711
    b. Valid through: September 30, 2025
    c. Version: 2.0
    d. Program operator: NSF International
4. Mineral wool board insulation
    a. Part B: Building Envelope Thermal Insulation EPD requirements
    b. Valid through: October 25, 2024

c. New version in development
d. Program operator: UL Environment

PART 2 - PRODUCTS
not used

PART 3 - EXECUTION

END OF SECTION 018113.19

SECTION 01 81 23 - CALGREEN REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes general requirements and procedures for compliance with certain provisions of the California Green Building Standards Code, also known and hereinafter referred to as the "Code."

1. Other prerequisites and credits needed to obtain Code compliance depend on material selections and may not be specifically identified as requirements for Code compliance. Compliance with requirements needed to obtain Code compliance may be used as one criterion to evaluate substitution requests and comparable product requests.
2. Additional requirements needed to obtain Code compliance depend on Architect's design and other aspects of Project that are not part of the Work of the Contract.
3. Sample compliance forms and worksheets are provided at the end of this Section, for information only. Provide required data in form acceptable to Architect and authorities having jurisdiction.

B. Related Sections:

1. Divisions 01 through 33 Sections for requirements for Code compliance specific to the work of each of these Sections.
2. Section 01 50 00 "Temporary Facilities and Controls" for storm water pollution prevention plan.
3. Section 01 74 19 "Construction Waste Management and Disposal" for construction waste management plan.
4. Section 01 91 13 "General Commissioning Requirements" for building commissioning.

1.2 REFERENCE

A. ARB: California Air Resources Board.

B. CCR: California Code of Regulations.

C. SCAQMD: South Coast Air Quality Management District.

1.3 DEFINITIONS

A. Building Commissioning: A systematic quality assurance process that spans the entire design and construction process, including verifying and documenting that building systems and components are planned, designed, installed, tested,

operated and maintained to meet the owner's project requirements.

B. Composite Wood Products: Composite wood products include hardwood plywood, particleboard and medium density fiberboard. "Composite wood products" does not include hardboard, structural plywood, structural panels, structural composite lumber, oriented strand board, glued laminated timber, prefabricated wood I-joists or finger-jointed lumber, all as specified in California Code of Regulations (CCR), Title 17, Section 93120.1(a).

C. Recycled Content: The percentage by weight of constituents that have been recovered or otherwise diverted from the solid waste stream, either during the manufacturing process (pre-consumer), or after consumer use (post-consumer).

1. Spills and scraps from the original manufacturing process that are combined with other constituents after a minimal amount of reprocessing for use in further production of the same product are not recycled materials.
2. Discarded materials from one manufacturing process that are used as constituents in another manufacturing process are pre-consumer recycled materials.

D. Recycled Content Value: Material cost multiplied by postconsumer content plus 1/2 the preconsumer content, or RCV = $ X (postconsumer content + 1/2 preconsumer content):

1. "Post-consumer waste" is defined as waste material generated by consumers after it is used and which would otherwise be discarded.
2. "Pre-consumer waste" is defined as material diverted from the waste stream during the manufacturing process, including scraps, damaged goods, and excess production that is used in another manufacturing process.

E. Maximum Incremental Reactivity (MIR): The maximum change in weight of ozone formed by adding a compound to the "Base Reactive Organic Gas (ROG) Mixture" per weight of compound added, expressed to hundredths of a gram.

1. MIR values for individual compounds and hydrocarbons solvents are specified in CCR, Title 17, Section 94700 and Section 94701.

F. Reactive Organic Compound (ROC): Any compound that has the potential, once emitted, to contribute to ozone formation in the troposphere.

G. Product-Weight MIR (PWMIR): The sum of all weighted-MIR for all ingredients in a product subject to this article. The PWMIR is the total product reactivity expressed to hundredths of a gram of ozone formed per gram of product (excluding container and packaging).

1. PWMIR is calculated according to equations found in CCR, Title 17, Section 94521(a).

H. VOC: A volatile organic compound (VOC) is broadly defined as a chemical compound based on carbon chains or rings with vapor pressures greater than 0.1

millimeters of mercury at room temperature. These compounds typically contain hydrogen and may contain oxygen, nitrogen and other elements. See CCR Title 17, Section 94508(a).

1. Note: Where specific regulations are cited from different agencies such as South Coast Air Quality Management District (SCAQMD), California Air Resources Board (ARB), etc., the VOC definition included in that specific regulation is the one that prevails for the specific measure in question.

1.4 SUBMITTALS

A. Documentation Submittals:

1. Receipts for salvaged and refurbished materials used for Project, indicating sources and costs for salvaged and refurbished materials.
2. Product data and certification letter indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content. Include statement indicating costs for each product having recycled content.
3. Construction Documentation: Six photographs at three different times during the construction period, along with a brief description of the approach employed, documenting protection of ducts and HVAC equipment.
4. Product data for adhesives, sealants and caulks, indicating VOC content of each product used. Indicate VOC content in g/L calculated according to SCAQMD Rule 1168 VOC limits and CCR Title 17 for aerosols.
5. Product data for paints and coatings, indicating VOC content of each product used. Indicate VOC content in g/L calculated according to the Air Resource Board Architectural Coatings Suggested Control Measure and CCAR Title 17 for aerosols.
6. Product data for carpet used inside the weatherproofing system indicating compliance with the Carpet and Rug Institute "Green Label Plus Program"; compliance with the VOC-emission limits and testing requirements specified in the California Department of Public Health Standard Practice Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers, Version 1.1, February.; compliance with NSF/ANSI 140 at the Gold Level or higher; compliance with (CA-CHPS) Criteria Interpretation for EQ 7.0 and EQ 7.1 dated July 2012 and listed in the CHPS High Performance Product database, or other standard accepted by authorities having jurisdiction.
7. Product data for carpet cushion used inside the weatherproofing system indicating compliance with the Carpet and Rug Institute "Green Label Program'.
8. Product data for resilient flooring indicating compliance with the VOC-emissions 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; compliance with the Collaborative for CA-CHPS Criteria Interpretation for EQ 7.0 and EQ 7.1 dated July 2012 and listed in the CHPS High Performance Product Database;

certification under UL GREENGUARD or certification under the Resilient Floor Covering Institute (RFCI) Floor Score program.

9. Product data, manufacturer's certifications, chain of custody certifications, or other documentation acceptable to authorities having jurisdiction; for products containing composite wood or agrifiber products or wood glues. Indicate compliance with ARB Air Toxics Control Measure for Composite Wood.
10. Product Data for residential appliances, indicating that products are ENERGY STAR rated.
11. Product data for carbon dioxide (CO2) sensors and controls.
12. Product data for HVAC, refrigeration, and fire suppression equipment and systems, indicating no use of Chlorofluorocarbons (CFCs) and Halons.
13. Product data for wood- burning appliances indicating compliance with requirements for direct venting as defined and required by the California Energy Code, Title 24, Part 6, Subchapter 7, Section 150, and for compliance with United State Environmental Protection Agency (USEPA) Phase II emission limits where applicable.
14. Product data for irrigation systems components including but not necessarily limited to the following:

    a. Sprinkler heads: Indicate degree of head rotation and spray characteristics/ pattern.
    b. Controllers and sensors.

15. Product data and schedules for plumbing fixtures and fittings. Include rated capacities and operating characteristics.
16. Product data, including photometrics, for interior and exterior lighting fixtures. Include Testing Agency and Manufacturer's certified data.
17. Qualifications data for HVAC system installers' certification. Include employee names, positions, dates of service, types of certification, certification program names, descriptions, dates of completion, and dates of expiration.

PART 2 - PRODUCTS

2.1 ADHESIVES, SEALANTS AND CAULKS

A. For field applications, use adhesives, sealants and caulks that comply with the indicated limits for VOC content when calculated according to SCAQMD Rule 1168 VOC limits and CCR Title 17 for aerosols.

2.2 PAINTS AND COATINGS

A. For field applications, use paints and coatings that comply with the indicated limits for VOC content when calculated according to CEPA Air Resources Board Architectural Coatings Suggested Control Measure and CCR Title 17 for aerosols.

Additionally, comply with more stringent local limits where they occur.

B. Coatings that do not meet the definitions for the specialty coatings categories indicated above 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.

2.3 COMPOSITE WOOD

A. Composite wood must comply with indicated limits for formaldehyde as derived from those specified by the ARB'ȼs, Air Toxics Control Measure (ATCN)for Composite Wood in accordance with ASTM E 1333-96, and as specified in CCR, Title 17, Sections 93120 through 93120.12.

2.4 RESILIENT FLOORING SYSTEMS

A. For 80% of the floor area receiving resilient flooring, installed resilient flooring shall meet at least one of the following:

1. Compliant with the VOC-emissions 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;
2. Certified under the Resilient Floor Covering Institute (RFCI) FloorScore program;
3. Compliant with the Collaborative for High Performance Schools California (CA-CHPS) Criteria Interpretation for EQ 7.0 and EQ 7.1 dated July 2012 and listed in the CHPS High Performance Product Database;
4. Products certified under UL GREENGUARD.

2.5 LIGHT POLUTION

A. All new lighting shall comply with the following in accordance with 5.106.8 and 10.106.8:

1. Outdoor lighting systems, with the exception of emergency lighting, shall be designed and installed to comply with the following:

    a. The minimum requirements in the California Energy Code for Lighting Zones 1-4 as defined in Chapter 10 of the California Administrative Code; and
    b. Backlight, Uplight and Glare (BUG) ratings as defined in IES TM-15-11; and
    c. Allowable BUG ratings not exceeding those shown in California Green Building Standards Code (CALgreen) Table 5.106.8.

2.6 ENERGY STAR

A. In accordance with CAL green A5.303.3, new residential grade equipment appliances provided and installed shall be ENERGY STAR labeled if ENERGY STAR is

applicable to that equipment or appliance.

2.7 PLUMBING

A. New plumbing fixtures and fittings shall comply with CALgreen Section 5.303.3.

PART 3 - EXECUTION

3.1 CONSTRUCTION WASTE MANAGEMENT

A. Comply with Section 01 74 19 "Construction Waste Management and Disposal."

3.2 BUILDING COMMISSIONING

A. Comply with Section 01 19 13 "General Commissioning Requirements."

3.3 TESTING, ADJUSTING, AND BALANCING

A. Develop a written plan of procedures for testing and adjusting systems. Systems to be included for testing and adjusting shall include, as applicable to the project:

1. HVAC systems and controls.
2. Indoor and outdoor lighting and controls.
3. Water heating systems.
4. Renewable energy systems.
5. Landscape irrigation systems.
6. Water reuse systems.

B. At the completion of testing, balancing, and adjusting, provide to the Owner a final report, signed by the person responsible for its content, documenting procedures utilized, findings, corrective actions, and final results.

C. Provide system operating and maintenance manuals to the Owner. See Section 01 78 23 "Operation and Maintenance Data" for requirements.

END OF SECTION 01 81 23

SECTION 01 91 13 - GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Owner's Project Requirements (OPR) and Basis of Design (BoD) documentation are included by reference for information only.

1.2 SUMMARY

A. Section includes general requirements that apply to the implementation of commissioning without regard to specific systems, assemblies, or components.

B. Related Requirements:

1. Specifications for specific areas of work requiring commissioning:

a. Division 22, Plumbing: Commissioning of Plumbing for commissioning process activities for plumbing systems, assemblies, equipment, and components.
b. Division 23, Heating, Ventilation, and Air Conditioning (HVAC): Commissioning of HVAC for commissioning process activities for HVAC&R systems, assemblies, equipment, and components.
c. Division 26, Electrical: Commissioning of Electrical Systems for commissioning process activities for electrical systems, assemblies, equipment, and components.
d. Division 27, Communications: Commissioning of Communications Systems, for commissioning process activities for communications systems, assemblies, equipment, and components.
e. Division 28, Electronic Safety and Security: Commissioning of Electronic Safety and Security for commissioning process activities for electronic safety and security systems, assemblies, equipment, and components.

1.3 DEFINITIONS

A. BoD: Basis of Design. A document that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.

B. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

C. CxA: Commissioning Authority.

D. OPR: Owner's Project Requirements. A document that details the functional requirements of a Project and the expectations of how it will be used and operated. These include Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.

E. 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 COMMISSIONING TEAM

A. Members Appointed by Contractor(s): Individuals, each having the authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated action. The commissioning team shall consist of, but not be limited to, representatives of each Contractor whose work is to be commissioned, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.

B. Members Appointed by Owner:

1. CxA: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. Owner will engage the CxA under a separate contract.

2. Representatives of the facility user and operation and maintenance personnel.
3. Architect and engineering design professionals.

1.5 OWNER'S RESPONSIBILITIES

A. Provide the OPR documentation to the CxA, the Architect, and each Contractor for information and use.

B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.

C. Provide the BoD documentation, prepared by the Architect and approved by Owner, to the CxA and each Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.

1.6 EACH CONTRACTOR'S RESPONSIBILITIES

A. Each Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:

1. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
2. Cooperate with the CxA for resolution of issues recorded in the Issues Log.
3. Attend commissioning team meetings held in conjunction with the regularly scheduled construction meeting.
4. Integrate and coordinate commissioning process activities with construction schedule.
5. Review and accept construction checklists provided by the CxA.
6. Complete paper or electronic construction checklists as Work is completed and provide to the Commissioning Authority on a weekly basis.
7. Review and accept commissioning process test procedures provided by the Commissioning Authority.
8. Complete commissioning process test procedures.

1.7 CxA'S RESPONSIBILITIES

A. Organize and lead the commissioning team.

B. Provide commissioning plan.

C. Convene commissioning team meetings.

D. Provide Project-specific construction checklists and commissioning process test procedures.

E. Verify the execution of commissioning process activities using random sampling. The sampling rate may vary from 1 to 100 percent. Verification will include, but is not limited to, equipment submittals, construction checklists, training, operating and maintenance data, tests, and test reports to verify compliance with the OPR. When a random sample does not meet the requirement, the CxA will report the failure in the Issues Log.

F. Prepare and maintain the Issues Log.

G. Prepare and maintain a completed construction checklist log.

H. Witness systems, assemblies, equipment, and component startup.

I. Compile test data, inspection reports, and certificates; include them in the systems manual and commissioning process report.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 GENERAL EXECUTION REQUIREMENTS - COMMISSIONING

A. Schedule and coordinate commissioning with the Contractor's construction schedule.

B. Perform activities identified in construction checklists, including tests, and document results of actions as construction proceeds.

C. Installing contractors' commissioning responsibilities include, but are not limited to, the following:

1. Operating the equipment and systems they install during tests.
2. In addition, installing contractors may be required to assist in tests of equipment and systems with which their work interfaces.

END OF SECTION 01 91 13

SECTION 031500 - CONCRETE ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Waterstops.
2. Vapor retarders beneath slabs on grade.

B. Related Sections:
1. Division 31 Section "Earthwork" for drainage fill and subbase under slabs-on-grade.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated:

PART 2 - PRODUCTS

2.1 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 (19 by 25 mm).
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following: Carlisle Coatings & Waterproofing, Inc.; CCW MiraStop.
a. CETCO; Volclay Waterstop-RX.
b. Concrete Sealants Inc.; Conseal CS-231.
c. Henry Company; Hydro-Flex.
d. JP Specialties, Inc.; Earth Shield Type 20.
e. Sika Corporation; Swellstop.
2. Locations: For joints in 8-inch or greater concrete with a minimum concrete coverage of 3 inches and subject to a hydrostatic head no greater than 200 feet.

2.2 VAPOR RETARDERS

A. Sheet Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.
1. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
a. Stego Industries, LLC; Stego Wrap.
b. W. R. Meadows, Inc.; Perminator.

PART 3 - EXECUTION

3.1 INSTALLATION OF WATERSTOPS

A. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated on Drawings, according to manufacturer's written instructions, by adhesive bonding, mechanically fastening, and firmly pressing into place.
   1. Install in longest lengths practicable.
   2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
   3. Protect exposed waterstops during progress of the Work.

3.2 VAPOR RETARDERS

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 (150 mm) and seal with manufacturer's recommended tape.

END OF SECTION

SECTION 032000 - CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel reinforcement bars.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review the following:

a. Special inspection and testing and inspecting agency procedures for field quality control.
b. Construction contraction and isolation joints.
c. Steel-reinforcement installation.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Each type of steel reinforcement.
2. Epoxy repair coating.
3. Zinc repair material.
4. Bar supports.
5. Mechanical splice couplers.
6. Structural thermal break insulated connection system.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content.

C. Shop Drawings: Comply with ACI SP-066:

1. Include placing drawings that detail fabrication, bending, and placement.
2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.
3. For structural thermal break insulated connection system, indicate general configuration, insulation dimensions, tension bars, compression pads, shear bars,

and dimensions.

D. Construction Joint Layout: Indicate proposed construction joints required to build the structure.

1. Location of construction joints is subject to approval of Architect.

E. Delegated Design Submittal: For structural thermal break insulated connection system, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Statements: For testing and inspection agency.

B. Delegated Design Engineer Qualifications: Include the following:

1. Experience providing delegated design engineering services of the type indicated.
2. Documentation that delegated design engineer is licensed in the jurisdiction in which Project is located.

C. Welding certificates.

1. Reinforcement To Be Welded: Welding procedure specification in accordance with AWS D1.4/D1.4M.

D. Material Certificates: For each of the following, signed by manufacturers:

1. Epoxy-Coated Reinforcement: CRSI's "Epoxy Coating Plant Certification."
2. Dual-Coated Reinforcement: CRSI's "Epoxy Coating Plant Certification."

E. Material Test Reports: For the following, from a qualified testing agency:

1. Steel Reinforcement:

a. For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM A706/A706M.

2. Mechanical splice couplers.

F. Field quality-control reports.

G. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing

indicated.

B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4/D 1.4M.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

1. Store reinforcement to avoid contact with earth.
2. Do not allow epoxy-coated reinforcement to be stored outdoors for more than 60 days without being stored under an opaque covering.
3. Do not allow dual-coated reinforcement to be stored outdoors for more than 60 days without being stored under an opaque covering.
4. Do not allow stainless steel reinforcement to come into contact with uncoated reinforcement.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

A. Recycled Content: Provide manufacturer documentation for recycled content, indicating postconsumer and preconsumer recycled content.

B. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.

C. Welded Reinforcing Bars: ASTM A706/A706M.

D. Headed-Steel Reinforcing Bars: ASTM A970/A970M.

2.2 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A615/A615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. Epoxy-Coated Joint Dowel Bars: ASTM A615/A615M, Grade 60, plain-steel bars, ASTM A775/A775M epoxy coated.

C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.

1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.

b. For epoxy-coated reinforcement, use CRSI Class 1A epoxy-coated or other dielectric-polymer-coated wire bar supports.
c. For dual-coated reinforcement, use CRSI Class 1A epoxy-coated or other dielectric-polymer-coated wire bar supports.
d. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.
e. For stainless steel reinforcement, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.

D. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.

1. Finish: Plain.

E. Stainless Steel Tie Wire: ASTM A1022/A1022M, not less than 0.0508 inch in diameter.

F. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A775/A775M.

G. Zinc Repair Material: ASTM A780/A780M.

2.3 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

PART 3 - EXECUTION

3.1 PREPARATION

A. Protection of In-Place Conditions:

1. Do not cut or puncture vapor retarder.
2. 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.

3.2 INSTALLATION OF STEEL REINFORCEMENT

A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.

B. Accurately position, support, and secure reinforcement against displacement.

1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
2. Do not tack weld crossing reinforcing bars.

C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.

D. Provide concrete coverage in accordance with ACI 318.

E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

F. Splices: Lap splices as indicated on Drawings.

1. Bars indicated to be continuous, and all vertical bars to be lapped not less than 36 bar diameters at splices, or 24 inches, whichever is greater.
2. Stagger splices in accordance with ACI 318.
3. Mechanical Splice Couplers: Install in accordance with manufacturer's instructions.
4. Weld reinforcing bars in accordance with AWS D1.4/D 1.4M, where indicated on Drawings.

G. Install structural thermal break insulated connection system in accordance with manufacturer's instructions.

H. Install welded-wire reinforcement in longest practicable lengths.

1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."

a. For reinforcement less than W4.0 or D4.0, continuous support spacing to not exceed 12 inches.

2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches for plain wire and 8 inches for deformed wire.
3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
4. Lace overlaps with wire.

3.3 JOINTS

A. 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.
2. Continue reinforcement across construction joints unless otherwise indicated.
3. Do not continue reinforcement through sides of strip placements of floors and slabs.

B. 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.

3.4 INSTALLATION TOLERANCES

A. Comply with ACI 117.

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 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 mechanical splice couplers.
3. Steel-reinforcement welding.

D. Manufacturer's Inspections: Engage manufacturer of structural thermal break insulated connection system to inspect completed installations prior to placement of concrete, and to provide written report that installation complies with manufacturer's written instructions.

END OF SECTION

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:

1. Footings / Foundations.
2. Foundation walls.
3. Slabs-on-grade.
   a. Exterior continuation of slab-on-grade (same mix design).
4. Landscape amphitheater seating.
5. Landscape walls. (Retaining wall, Plaza wall, Planter curb wall, and Seat wall)
6. Landscape stairs.

B. Related Sections:
1. Section 031500 “Concrete Accessories” for waterstops and sub-slab vapor barriers.
2. Section 032000 “Concrete Reinforcing.”
3. Section 033503 “Concrete Slab Finishing.”
4. Section 033543 “Polished Concrete Finishing.”
5. Section 035216 “Lightweight Insulating Concrete.”
6. Section 035411 “Floor Substrate Preparation" for unreinforced, self-leveling and trowelable underlayment and traffic bearing topping.
7. Section 096723 “Resinous Flooring.”
8. Section 220548 “Vibration and Seismic Controls for Plumbing” for additional requirements for concrete embeds related to plumbing.
9. Section 230548 Vibration and Seismic Controls for HVAC for additional requirements for concrete embeds related to HVAC.
10. Section 321300 “Concrete Paving” for site cast-in-place concrete paving.
11. Section 321313 “Site Concrete Finishes” for site concrete receiving decorative finishes.

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Sustainable Design Submittals:

1. Environmental Product Declarations: Submit product-specific Type III environmental product declarations (EPD) with third-party certification, including external verification, in which the manufacturer is explicitly recognized as a participant by the program operator for all mix designs. EPDs must conform to ISO 14025 and EN 15804 or ISO 21930 and have at least a cradle-to-gate scope. Industry-wide EPDs are acceptable as an alternate to product-specific EPDs upon request.
2. Recycled Content: for products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
3. Low-Embodied Carbon: Submit product-specific documentation of mix design embodied carbon levels.

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. 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.

2. For multi-story construction, submit calculations stamped by a licensed engineer in the state where the Project is located.

F. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

1. Location of construction joints is subject to approval of the Architect and Structural Engineer.

1.4 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, indicating compliance with requirements:

1. Aggregates.

E. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

F. Field quality-control reports.

G. Minutes of preinstallation conference.

1.5 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. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, 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.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."

F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5 and Section 7, "Lightweight Concrete".
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests.

H. 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.
c. Ready-mix concrete manufacturer.
d. Concrete subcontractor.
e. Special concrete finish subcontractor.
f. Owner representative.
g. Structural Engineer

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, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement, if applicable.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish 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.

B. Refer to Section 321313 "Site Concrete Finishes" for site concrete receiving decorative concrete formed finishes.

C. 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.

2.2 STEEL REINFORCEMENT

A. Refer to Section 032000 "Concrete Reinforcing."

2.3 CONCRETE MATERIALS

A. Cementitious Materials: Conform to the structural drawings general notes requirements.

B. Normal-Weight Aggregates: Conform to ASTM C33 and the structural drawings general notes requirements.

C. Lightweight Aggregate: Conform to ASTM C 330 and the structural drawings general notes requirements.

D. Water: ASTM C 94 and potable.

2.4 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

C. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C 494/C 494M, Type C.

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. Axim Italcementi Group, Inc.; CATEXOL CN-CI.
b. BASF Construction Chemicals - Building Systems; Rheocrete CNI.
c. Euclid Chemical Company (The), an RPM company; [ARRMATECT] [EUCON BCN] [EUCON CIA].
d. Grace Construction Products, W. R. Grace & Co.; DCI.
e. Sika Corporation; Sika CNI.

D. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

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. BASF Construction Chemicals - Building Systems; Rheocrete 222+.
b. Cortec Corporation; MCI- [2000] [2005NS].
c. Grace Construction Products, W. R. Grace & Co.; DCI-S.
d. Sika Corporation; FerroGard 901.

E. Color Pigment: Refer to Section 321313 “Site Concrete Finishes” for colored concrete requirements in site concrete.

2.5 WATERSTOPS AND VAPOR RETARDERS

A. Refer to Section 031500 “Concrete Accessories” for waterstops and sub-slab vapor barriers.

2.6 SLAB TREATMENTS

A. Refer to Section 033503 “Concrete Slab Finishing.”

B. Refer to Refer to Section 033543 “Polished Concrete Finishing.”

C. Refer to Section 035411 “Floor Substrate Preparation" for unreinforced, self-leveling and trowelable underlayment and traffic bearing topping.

2.7 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

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. Axim Italcementi Group, Inc.; CATEXOL CimFilm.
    b. BASF Construction Chemicals - Building Systems; Confilm.
    c. ChemMasters; SprayFilm.
    d. Conspec by Dayton Superior; Aquafilm.
    e. Dayton Superior Corporation; Sure Film (J-74).
    f. Edoco by Dayton Superior; BurkeFilm.
    g. Euclid Chemical Company (The), an RPM company; Eucobar.
    h. Kaufman Products, Inc.; Vapor-Aid.
    i. Lambert Corporation; LAMBCO Skin.
    j. L&M Construction Chemicals, Inc.; E-CON.
    k. Meadows, W. R., Inc.; EVAPRE.
    l. Metalcrete Industries; Waterhold.
    m. Nox-Crete Products Group; MONOFILM.
    n. Sika Corporation; SikaFilm.
    o. SpecChem, LLC; Spec Film.
    p. Symons by Dayton Superior; Finishing Aid.
    q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
    r. Unitex; PRO-FILM.
    s. Vexcon Chemicals, Inc.; Certi-Vex Envio Set.

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.

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. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
    b. BASF Construction Chemicals - Building Systems; Kure 200.
    c. ChemMasters; Safe-Cure Clear.
    d. Conspec by Dayton Superior; W.B. Resin Cure.
    e. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
    f. Edoco by Dayton Superior; Res X Cure WB.
    g. Euclid Chemical Company (The), an RPM company; Kurez W VOX; TAMMSCURE WB 30C.
    h. Kaufman Products, Inc.; Thinfilm 420.
    i. Lambert Corporation; AQUA KURE - CLEAR.
    j. L&M Construction Chemicals, Inc.; L&M Cure R.
    k. Meadows, W. R., Inc.; 1100-CLEAR.
    l. Nox-Crete Products Group; Resin Cure E.
    m. Right Pointe; Clear Water Resin.

n. SpecChem, LLC; Spec Rez Clear.
o. Symons by Dayton Superior; Resi-Chem Clear.
p. TK Products, Division of Sierra Corporation; TK-2519 DC WB.
q. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.

2. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class 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. BASF Construction Chemicals - Building Systems; Kure 1315.
b. ChemMasters; Polyseal WB.
c. Conspec by Dayton Superior; Sealcure 1315 WB.
d. Edoco by Dayton Superior; Cureseal 1315 WB.
e. Euclid Chemical Company (The), an RPM company; Super Diamond Clear VOX; LusterSeal WB 300.
f. Kaufman Products, Inc.; Sure Cure 25 Emulsion.
g. Lambert Corporation; UV Safe Seal.
h. L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
i. Meadows, W. R., Inc.; Vocomp-30.
j. Metalcrete Industries; Metcure 30.
k. Right Pointe; Right Sheen WB30.
l. Symons by Dayton Superior; Cure & Seal 31 Percent E.
m. Vexcon Chemicals, Inc.; Vexcon Starseal 1315.

2. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.8 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.

C. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

D. 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, non-load bearing or Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete, as required for repair procedure.

E. Reglets: Fabricate reglets of not less than 0.022-inch-thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

F. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch-thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.9 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 28 day strength of concrete to be repaired 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 28 day strength of concrete to be repaired when tested according to ASTM C 109.

2.10 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: Conform to structural drawings general notes requirements.

C. Water-soluble, chloride-ion content in hardened concrete to conform to structural drawings general notes requirements.

D. 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 as required in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

E. Color Pigment: If applicable, add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.11 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Proportion concrete mixtures in accordance with the structural drawings general notes requirements.

2.12 FABRICATING REINFORCEMENT

A. Refer to 032000 “Concrete Reinforcing.”

2.13 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/C 94M. 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

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, or stricter if required by the structural drawings or construction sequencing.

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. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

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.

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.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 75 percent of its 28-day design compressive strength.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 SHORES AND RESHORES

A. Comply with 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 RETARDERS

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.

B. Refer to Section 031500 “Concrete Accessories” for vapor retarders.

3.6 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
2. Refer to Section 032000 “Concrete Reinforcing.”

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4, only where indicated in structural drawings.

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.

F. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.

G. Zinc-Coated Reinforcement: Repair cut and damaged zinc coatings with zinc repair material according to ASTM A 780. Use galvanized steel wire ties to fasten zinc-coated steel reinforcement.

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 and structural engineer.

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 basement/perimeter walls at maximum 20 feet on center spacing. 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.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

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 one-half of dowel length to prevent concrete bonding to one side of joint.

3.8 WATERSTOPS

A. Flexible Refer to Section 031500 "Concrete Accessories" for waterstops.

3.9 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by structural engineer.

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 will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

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.

F. 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.

G. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.10 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to 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, to receive a rubbed finish, to be covered with a coating or covering material applied directly to concrete.

C. Refer to Section 321313 “Site Concrete Finishes” for site concrete receiving decorative concrete formed finishes.

D. 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 one part portland cement to one and one-half 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 will match 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.

3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

E. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.11 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.

1. Apply scratch finish to surfaces indicated and to receive concrete floor toppings or to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces indicated to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces 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 surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:
    a. Specified overall values of flatness, F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15; for slabs-on-grade.
    b. Specified overall values of flatness, F(F) 30; with minimum local values of flatness, F(F) 24; for suspended slabs.

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

G. Slip-Resistive Finish: Before final floating, apply slip-resistive aluminum granule finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions and as follows:

1. Uniformly spread 25 lb/100 sq. ft. of dampened slip-resistive aluminum granules over surface in one or two applications. Tamp aggregate flush with surface, but do not force below surface.
2. After broadcasting and tamping, apply float finish.
3. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aluminum granules.

H. Dry-Shake Floor Hardener Finish: After initial floating, apply dry-shake floor hardener to surfaces according to manufacturer's written instructions and as follows:

1. Uniformly apply dry-shake floor hardener at a rate of 100 lb/100 sq. ft. unless greater amount is recommended by manufacturer.
2. Uniformly distribute approximately two-thirds of dry-shake floor hardener over surface by hand or with mechanical spreader, and embed by power floating. Follow power floating with a second dry-shake floor hardener application, uniformly distributing remainder of material, and embed by power floating.
3. After final floating, apply a trowel finish. Cure concrete with curing compound recommended by dry-shake floor hardener manufacturer and apply immediately after final finishing.

3.12 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at

correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

3.13 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

    a. Water.
    b. Continuous water-fog spray.
    c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

    a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
    b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
    c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

    a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

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 TREATMENTS

A. Refer to Section 033503 "Concrete Slab Finishing" for sealer application.

B. Refer to Refer to Section 033543 "Polished Concrete Finishing" for sealers, densifiers, hardeners for polished concrete floors.

C. Refer to Section 035411 "Floor Substrate Preparation" for sealers for unreinforced, self-leveling and trowelable underlayment and traffic bearing topping.

3.15 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least six months. Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

D. Refer to Section 033503 "Concrete Slab Finishing" for concrete floor joint application.

3.16 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

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

A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing and Inspecting: 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.
8. Formwork dimensions.

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: Samples for strength tests of each concrete mixture placed each day shall be taken not less than once a day, nor less than once for each 150 cu. yd. of concrete.

    a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31.

    a. Cast and cure two sets of two standard cylinder (6x12 in) specimens or three 4x8 in specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C 39; test specimens as required by structural drawings general notes requirements.

    a. A compressive-strength test shall be the average compressive strength from a set of two 6x12 in (or three 4x8 in) specimens obtained from same composite sample and tested at age indicated.

7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
8. 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.
9. Test results shall be reported in writing to Architect, structural engineer, 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 specified age of test.
10. 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.
11. 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 / structural engineer. 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.
12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
13. 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 ASTM E 1155 within 48 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

SECTION 033503 - CONCRETE SLAB FINISHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Concrete finish requirements for unformed horizontal concrete surfaces. This section supplements requirements of Section 033000 "Cast-in-Place Concrete."

B. Related Sections:
1. Section 035411 "Floor Substrate Preparation" for unreinforced, self-leveling and trowelable underlayment and traffic bearing topping.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Sustainable Design Submittals:
1. Laboratory Test Reports: For sealers, indicating compliance with requirements for low-emitting materials.

1.3 QUALITY ASSURANCE

A. Standards: Comply with the following documents, except where requirements of the contract documents are more stringent:
1. ACI 301.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sustainable Design Performance Requirements:
1. Sealers shall comply with the following:
a. Low Emitting Materials: Testing and product requirements of the California Department of Health Services CDPH Standard Method v1.1, CA Section 01350, Appendix B, New Single-Family Residence Scenario.

2.2 CONCRETE SLAB SEALER

A. Concrete Slab Sealer: Liquid chemical hardener; siliconate type; compatible with specified floor coverings and installation methods. Provide one of the following:
1. Curecrete Distribution Inc.; Ashford Formula (enhanced silicate, not siliconate).
2. Dayton Superior; Sure Hard Densifier J17.

3. Euclid Chemical Company (The); an RPM company; Euco Diamond Hard.
4. Laticrete International, Inc.; L&M Seal Hard.

2.3 MISCELLANEOUS MATERIALS AND ACCESSORIES

A. Contraction Joint Filler:
   1. Sealant: As specified in Section 079200 "Joint SEalants.

B. Concrete Cleaner: Liquid concentrate, biodegradable, heavy-duty cleaner-degreaser compound.

PART 3 - EXECUTION

3.1 FINISHING FLOORS AND SLABS

A. Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Float Finish: When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete 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 until surface is left with a uniform, smooth, granular texture and complies with ACI 117 tolerances for conventional concrete.
   1. Apply float finish to surfaces as follows:
      a. To receive trowel finish.
      b. To be covered with fluid-applied or sheet waterproofing
      c. Other surfaces indicated.

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. Do not add water to concrete surface. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
   1. Apply a trowel finish to surfaces as follows:
      a. Exposed to view.
      b. To be covered with resilient flooring, carpet, paint, or another thin-film-finish coating system.
      c. Other surfaces as indicated.
   2. Finish surfaces to the following tolerances:
      a. 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, unless specified floor covering requires more stringent tolerance.

D. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces. While concrete is still plastic, slightly scarify surface with a fine broom perpendicular to main traffic route.

1. Apply a towel and fine broom finish to surfaces as follows:
   a. To receive ceramic or quarry tile installed by either thickset or thinset method.
   b. Other surfaces indicated.
2. Coordinate required final finish with Architect before application.
3. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

E. Broom Finish: Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
1. Apply a broom finish to surfaces as follows:
   a. Exterior concrete platforms, steps, and ramps.
   b. Other surfaces indicated.
2. Coordinate required final finish with Architect before application.

3.2 REPARING SLAB SURFACES

A. Test slab surfaces for smoothness, and verify surface tolerances specified for each surface. Repair defects as follows:
1. High Areas: After concrete has cured at least 14 days, correct high areas by grinding.
2. Low areas: Finish repaired areas to blend with adjacent concrete. Proprietary patching compounds may be used when approved by the Architect.
3. Crazed or cracked areas: Cut out defective areas, except random cracks and single holes not exceeding 1 inch in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts. Dampen exposed concrete and apply bonding compound. Mix, place, compact, and finish patching concrete to match adjacent concrete.
4. Isolated cracks and holes: Groove top of cracks and cut out holes not over 1 inch in diameter. Dampen cleaned concrete surfaces and apply bonding compound; place dry pack or proprietary repair compound acceptable to Architect while bonding compound is still active:
   a. Dry-pack mix: One part portland cement to 2-1/2 parts fine aggregate and enough water as required for handling and placing.
   b. Install patching mixture and consolidate thoroughly, striking off level with and matching surrounding surface. Do not allow patched areas to dry out prematurely.

B. Fill in holes and openings left in concrete structures for passage of work by other trades after such work is in place. Place such fill-in concrete to blend with existing construction, using same mix and curing methods.

3.3 SEALED CONCRETE FLOORS

A. Concrete Slab Sealer:
1. Apply sealer/finish following manufacturer's printed application instructions; apply single saturation coat.
2. Remove surplus sealer/hardener and rinse according to manufacturer's instructions.

3. Burnishing: Prior to substantial completion, apply light second coat of chemical sealer-hardener material and polish using mild abrasives or brushes in accordance with sealer/hardener manufacturer's recommendations. Buff to even satin sheen.
4. Location: At all interior, exposed slabs subject to pedestrian traffic, unless indicated otherwise.

END OF SECTION

SECTION 033543 - POLISHED CONCRETE FINISHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Polished concrete finishing.

B. Related Sections:
   1. Section 033000 "Cast-in-Place Concrete" for concrete for polished concrete, including concrete materials, mixture design, placement procedures, and curing.
   2. Section 033503 "Concrete Slab Finishing" for flatness and levelness requirements, and initial finishing for polished concrete.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Review methods and procedures related to polished concrete finishing including, but not limited to, the following:
      a. Inspect and discuss condition of substrate and other preparatory work including concrete repair procedures.
      b. Review and finalize construction schedule and verify availability of materials, Installer's personnel, and equipment.
      c. Review special designs and patterns.
      d. Review protection of polished concrete.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:
   1. Laboratory Test Reports: For liquid floor treatments, indicating compliance with requirements for low-emitting materials.

C. Polishing Schedule: Submit plan showing polished concrete surfaces and schedule of polishing operations for each area of polished concrete before start of polishing operations. Include locations of all joints, including construction joints.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A company experienced in performing specified work similar in design, products, and extent to scope of this Project; with a record of successful in-service performance; and with sufficient production capability, facilities, and personnel to produce specified work.

1.6 MOCKUPS

A. Build mockup 10 by 10 ft (3.05 by 3.05 m) to verify selections made under submittals and to demonstrate typical joints, surface finish, 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 of the Work and of the size indicated or, if not indicated, as directed by Architect for newly placed concrete.
   2. Demonstrate surface preparation, tested aggregate exposure, tested polish appearance, sealing and protecting of polished concrete.
   3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
   4. 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 PERFORMANCE REQUIREMENTS

A. Sustainable Design Performance Requirements:
   1. Liquid floor treatments shall comply with the following:
      a. Low-Emitting Materials: Testing and product requirements of the California Department of Health Services CDPH Standard Method v1.1.
      b. VOC Content: Not more than 100 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Coefficient of Friction: Provide polished concrete with the following values as determined by testing identical products:
   1. Level Surfaces Not Subject to Wetting: SCOF of not less than 0.50 in accordance with ANSI A1264.2 Section E11.2.
   2. Level Surfaces Subject to Wetting: DCOF of not less than 0.42 in accordance with ANSI A137.1.

2.2 MANUFACTURERS

A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   1. Advanced Floor Products; Retro Plate System.
   2. Scofield, a Business Unit of Sika Corporation; Formula One System.

3. Vexcon Chemicals Inc.; Certi-Shine System.

2.3 MATERIALS

A. Penetrating Liquid Floor Treatments for Polished Concrete Finish: Clear, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for polished concrete surfaces.

PART 3 - EXECUTION

3.1 APPLICATION, GENERAL

A. Place, rough grind, fine grind, and finish according to manufacturer's written instructions.

3.2 POLISHING

A. Apply polished concrete finish system to cured and prepared slabs.
1. Machine grind floor surfaces to receive polished finishes level and smooth.
2. Apply reactive stain for polished concrete in polishing sequence and according to manufacturer's written instructions.
3. Apply penetrating liquid floor treatment for polished concrete in polishing sequence and according to manufacturer's written instructions, allowing recommended drying time between successive coats.
4. Control and dispose of waste products produced by grinding and polishing operations.
5. Neutralize and clean polished floor surfaces.

B. Aggregate Exposure Class: In accordance with ASCC's Concrete Polishing Council, based on visual observation of the overall area of the polished floor as follows:
1. Class A, Cement Fines: Surface exposure of 85 to 95 percent cement fines and 5 to 15 percent fine aggregate.
2. Class B, Fine Aggregate: Surface exposure of 85 to 95 percent fine aggregate and 5 to 15 percent cement fines and coarse aggregate.
3. Class C, Course Aggregate: Surface exposure of 80 to 90 percent coarse aggregate and 10 to 20 percent cement fines and fine aggregate.

C. Polished Concrete Appearance Level: In accordance with ASCC's Concrete Polishing Council, with haze index less than 10 in accordance with ASTM D4039, and as follows:
1. Level 1, Flat (Ground):
a. Distinctness-of-Image Gloss; ASTM D5767: Less than 9 percent.
b. Procedure: Not less than 4 step process with full refinement of each resin-bonded diamond pad with one application of densifier.
c. Grit Range: 100 or less.
2. Level 2, Satin (Honed):
a. Distinctness-of-Image Gloss; ASTM D5767: Between 10 and 39 percent.

b. Procedure: Not less than 5 step process with full refinement of each resin-bonded diamond pad with one application of densifier.
c. Grit Range: 100-400.

3. Level 3, Polished:
   a. Distinctness-of-Image Gloss; ASTM D5767: Between 40 and 69 percent.
   b. Procedure: Not less than 6 step process with full refinement of each resin-bonded diamond pad with one application of densifier.
   c. Grit Range: 800 and higher.
4. Level 4, Highly Polished:
   a. Distinctness-of-Image Gloss; ASTM D5767: Greater than 70 percent.
   b. Procedure: Not less than 7 step process with full refinement of each resin-bonded diamond pad with one application of densifier.
   c. Grit Range: 800 and higher.

3.3 CLEANING AND PROTECTION

A. Cleaning:
   1. Remove grinding dust from installation and adjacent areas.
   2. Wash surfaces with cleaner according to manufacturer's written instructions; rinse surfaces with water and allow them to dry thoroughly.

B. Protection: Provide final protection and maintain conditions that ensure that polished concrete floor is without damage or deterioration at time of Substantial Completion.

3.4 SCHEDULE

A. **CONC-1**
   1. Aggregate Exposure Class:
      a. Class C, Course Aggregate.
   2. Polished Concrete Appearance Level:
      a. Level 2, Satin (Honed).

B. **CONC-2**
   1. Aggregate Exposure Class:
      a. Class A, Cement Fines.
   2. Polished Concrete Appearance Level:
      a. Level 2, Satin (Honed).

END OF SECTION

SECTION 035411 - FLOOR SUBSTRATE PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Cement-based, polymer-modified, self-leveling and trowelable, underlayment.
2. Cement-based, self-leveling, traffic bearing topping.
3. Floor underlayment, grinding, sanding, and repair where concrete floors will not accept finish flooring specified.

B. Related Sections:
1. Section 035413 “Gypsum Cement Underlayment at areas indicated.
2. Division 09 Sections: For flooring system substrate requirements.
3. Structural General Notes for Lightweight Structural Concrete topping slab at areas indicated.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Sustainable Design Submittals:
1. Laboratory Test Reports: For primers and sealers, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: Include plans indicating substrates, locations, existing conditions which require repair, and average depths of underlayment based on survey of substrate conditions.

1.3 INFORMATIONAL SUBMITTALS

A. Compatibility Certificates: From flooring installers stating that underlayment material is compatible with flooring adhesives used to install finish flooring materials.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Installer who is approved by manufacturer for application of underlayment products required for this Project.

1.5 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sustainable Design Performance Requirements:
1. Primers and sealers shall comply with the following:
a. Low-Emitting Materials: Testing and product requirements of the California Department of Health Services CDPH Standard Method v1.1, using CA Section 01350, Appendix B, New Single-Family Residence Scenario.

2.2 UNDERLAYMENT

A. Self-Leveling Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in uniform thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
1. Compressive Strength: Not less than 4000 psi at 28 days when tested according to ASTM C109/C109M.
2. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch; or coarse sand as recommended by underlayment manufacturer for underlayment thickness required.
3. Water: Potable and at a temperature of not more than 70 deg F.
4. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
a. ARDEX Americas; ARDEX V 1200.
b. Laticrete International, Inc.; Levelex.
c. MAPEI Corporation; Ultraplan 1 Plus.
d. Silpro Raeco; SLU.

B. Trowelable Underlayment: Cement-based, polymer-modified, trowelable product that can be applied from a featheredge up to 1 inch, and up to three inches with addition of proper aggregate.
1. Compressive Strength: Not less than 4000 psi at 28 days when tested according to ASTM C 109.
2. Aggregate: Well-graded, washed 1/8 to 1/4 inch pea gravel.
3. Water: Potable and at a temperature of not more than 70 deg F.
4. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
a. ARDEX Americas; ARDEX SD-P.
b. Euclid Chemical Company (The); an RPM company; Tamms Thin Patch.
c. Laticrete International, Inc.; Laticrete 220 Marble and Granite Mortar mixed with Laticrete 3701 Mortar Admix.

2.3 TRAFFIC BEARING TOPPING

A. Self-Leveling Traffic-Bearing Topping: Cement-based self-leveling, no troweling, Portland cement-based topping for fast track resurfacing, smoothing, or leveling of indoor concrete that can be installed from 1/4 inch to 2 inch in one operation and up to 5 inches with the addition of appropriate aggregate.

1. Compressive Strength: Not less than 6000 psi at 28 days when tested according to ASTM C 109.
2. Aggregate: Well-graded, washed 1/8 to 1/4 inch inch pea gravel.
3. Water: Potable and at a temperature of not more than 70 deg F.
4. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   a. ARDEX Americas; ARDEX SD-T.
   b. Silpro Raeco; SLT.

2.4 MISCELLANEOUS MATERIALS AND ACCESSORIES

A. Provide patching compounds, sand fillers, and other products as recommended by the underlayment manufacturer for the conditions of the project.

B. Primer: Product of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.

C. Reinforcement: For underlayment applied to wood substrates, provide galvanized metal lath or other corrosion-resistant reinforcement recommended in writing by underlayment manufacturer.

D. 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 GENERAL

A. With the exception of areas where leveling can be accomplished by use of latex underlayment, as specified in other sections, install cementitious underlayment to concrete slabs as indicated on the Drawings, and as necessary to level slabs or bring substrates to proper elevation.

3.2 PREPARATION

A. 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: 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.

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. Adhesion Tests: After substrate preparation, test substrate for adhesion with underlayment according to manufacturer's written instructions.

3.3 INSTALLATION

A. Mix and install underlayment components according to manufacturer's written instructions.
   1. Close areas to traffic during underlayment installation and for time period after installation recommended in writing by manufacturer.
   2. Coordinate installation 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. Install underlayment to produce uniform, level surface.
   1. Install a final layer without aggregate to produce smooth surface.
   2. Feather edges to match adjacent floor elevations.

D. Cure underlayment according to manufacturer's written instructions. Prevent contamination during installation 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. Do not install topical vapor reducers over underlayment without written confirmation from underlayment manufacturer.

H. Remove and replace underlayment areas that evidence lack of bond with substrate, including areas that emit a "hollow" sound when tapped.

I. Finish to a smooth level surface within tolerances required for floor covering.

3.4 PROTECTION

A. Protect underlayment from concentrated and rolling loads for remainder of construction period.

3.5 SCHEDULE

A. Self-Leveling Underlayment: Provide at all concrete slabs as necessary to correct slab flatness and levelness tolerances.

B. Trowelable Underlayment: Provide at locations such as transitions between dissimilar floor coverings, ramps, and other areas where slopes are indicated.

C. Self-Leveling Traffic-Bearing Topping: Provide at locations indicated to remain exposed and subject to traffic.

END OF SECTION

SECTION 035413 - GYPSUM CEMENT UNDERLAYMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Self-leveling, gypsum cement underlayment for application below interior floor coverings.
2. Acoustic underlayment and isolation edge strips.

B. Related sections:
1. Structural General Notes for Lightweight Structural Concrete topping slab at areas indicated.
2. Section 035411 “Floor Substrate Preparation" for unreinforced, self-leveling and trowelable underlayment and traffic bearing topping.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Sustainable Design Submittals:
1. Laboratory Test Reports: For primers and sealers, indicating compliance with requirements for low-emitting materials.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Installer who is approved by manufacturer for application of underlayment products required for this Project.

B. Product Compatibility: Manufacturers of underlayment and floor-covering systems certify in writing that products are compatible.

1.4 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sustainable Design Performance Requirements:
   1. Primers and sealers shall comply with the following:
      a. Low-Emitting Materials: Testing and product requirements of the California Department of Health Services CDPH Standard Method v1.1, CA Section 01350, Appendix B, New Single-Family Residence Scenario.

B. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.

C. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.
   1. STC Rating: As indicated on Drawings.

D. IIC-Rated Assemblies: For IIC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E492 and classified according to ASTM E989 by an independent testing agency.
   1. IIC Rating: As indicated on Drawings.

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 to match adjacent floor elevations.
   1. Products: Subject to compliance with requirements, provide the following:
      a. Maxxon Corporation; Gyp-Crete or equal.
   2. Cement Binder: Gypsum or blended gypsum cement as defined by ASTM C219.
   3. Compressive Strength: Not less than 2200 psi at 28 days when tested according to ASTM C472.
   4. Thickness: As indicated on Drawings.
   5. Density: 115 pounds per cubic foot or greater for acoustic performance.

B. Water: Potable and at a temperature of not more than 70 deg F.

C. Reinforcement: For underlayment applied to wood substrates, provide galvanized metal lath or other corrosion-resistant reinforcement recommended in writing by underlayment manufacturer.

D. Primer: Product of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.

E. Surface Sealer: Designed to reduce porosity as recommended by manufacturer for type of floor covering to be applied to underlayment.

2.3 ACCESSORIES

A. Acoustic underlayment: As required to meet STC and IIC ratings, manufactured by gypsum cement underlayment manufacturer.
   1. Thickness: 1/4 inch unless otherwise indicated.
   2. Basis of design:
      a. Maxxon Acousti-Mat ¼".
      b. Or equal product that meets the same or better STC and IIC performance as the BOD product in acoustical tests of floor assemblies for which the product will be used.

B. Provide other accessories recommended by manufacturer for complete installation and to meet performance requirements including, but not limited to, the following:
   1. Perimeter isolation strips or acoustic sealant.
      a. Maxxon Acouti-Mat Iso Strips.
      b. Or equal product that meets the same or better STC and IIC performance as the BOD product in acoustical tests of floor assemblies for which the product will be used.

PART 3 - EXECUTION

3.1 PREPARATION

A. 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. 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.

C. Adhesion Tests: After substrate preparation, test substrate for adhesion with underlayment according to manufacturer's written instructions.

D. Acoustic underlayment: Install sound control materials according to manufacturer's written instructions.
   1. Do not install mechanical fasteners that penetrate through the sound control materials.

3.2 INSTALLATION

A. Mix and install underlayment components according to manufacturer's written instructions.
   1. Close areas to traffic during underlayment installation and for time period after installation recommended in writing by manufacturer.

2. Coordinate installation 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. Install underlayment to produce uniform, level surface.
1. Feather edges to match adjacent floor elevations.

D. Cure underlayment according to manufacturer's written instructions. Prevent contamination during installation 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.

3.3 INSTALLATION TOLERANCES

A. Finish and measure surface, so gap at any point between gypsum cement underlayment surface and an unleveled, freestanding, 10-foot- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.

END OF SECTION

SECTION 044000 – STONE ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all labor, materials, and equipment for the installation of exterior stone assemblies indicated on the Drawings and specified herein.

B. It is the design intent that all sandstone used in this project be of similar type, color, and finish to maintain a consistent appearance throughout the site.

C. Stone assemblies include, but are not limited to, the following:
1. Amphitheater seating with sandstone veneer, including horizontal top slab and vertical face.
2. Free-standing custom linear stone seating with steel framing and sandstone seat panels.
3. Built-in stone seating on plaza walls and supported by steel framing.

D. Related Sections:
1. Section 03 20 00, CONCRETE REINFORCING
2. Section 03 30 00, CAST-IN-PLACE CONCRETE
3. Section 05 60 00, LANDSCAPE METAL FABRICATIONS
4. Section 06 15 33, WOOD DECKING

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at [Project site] <Insert location>.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, including:
1. Natural sandstone: finish, source, and physical properties.
2. Mortar or adhesive materials.
3. Anchors, pins, dowels, brackets, or other attachment hardware.

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. Sustainable Design Submittals: Quarry source verification; stone sealer VOC content.

F. Shop Drawings: Indicate location, size, elevation, and construction details not covered in Product Data, including:
1. Veneer layout, jointing, and anchorage at amphitheater seating.

2. Free-standing seat frame and stone top assembly.
3. Built-in seat stone top with steel framing and anchorage.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Minimum 5 years experience installing exterior stone veneer and seating assemblies.

B. Stone shall be obtained from a single quarry/fabricator to ensure uniform color, veining, and texture.

1.5 MOCKUPS

A. Provide prior to fabrication and installation:
1. Amphitheater veneer and top slab (representative section).
2. Minimum 6 ft section of free-standing bench.
3. Minimum 6 ft section of built-in seating.
4. Approved mockups establish standard for workmanship, color, texture, joint width, and anchorage.

1.6 PRODUCT HANDLING

A. Store materials where under cover, off the ground, in a dry area.

1.7 PROJECT CONDITIONS

A. Lay masonry only when ambient temperature is above 40 degrees F. Protect work from cold and frost, ensuring that mortar will harden without freezing. Do not place concrete footings on muddy or frozen surfaces.

1.8 COORDINATION WITH CUSTOM SEATING

1. Coordinate the design, fabrication, and delivery of custom seating assemblies that incorporate wood, steel, and stone components.
2. Coordinate fabrication and installation of stone assemblies that are part of the custom seating assemblies with LandscapeForms Studio 431 or approved equal (EQ).
3. Ensure full coordination between trades responsible for:
   a. Steel framing and anchorage.
   b. Stone seat panels and veneers.
   c. Wood seat elements and finishes.
4. Confirm compatibility of materials, finishes, and dimensions across all components prior to fabrication.
5. Submit a comprehensive coordination plan including:
   a. Steel, Wood, and Stone Shop Drawings to be coordinated and submitted at the same time for review and approval.
   b. Delivery schedule and lead times.
   c. Installation sequencing and interface details.
6. Coordinate with the following sections for seamless execution:

a. Section 05 60 00, LANDSCAPE METAL FABRICATIONS
b. Section 06 15 33, WOOD DECKING

PART 1 - PRODUCTS

1.1 PERFORMANCE REQUIREMENTS

A. Stone: Natural sandstone similar to Santa Barbara Sandstone.

1. Compressive Strength ≥ 4,000 psi (ASTM C170).
2. Water Absorption ≤ 6% (ASTM C97).

B. Anchors, pins, and fasteners: Stainless steel, ASTM A666 Type 304.

C. Sustainable Design: Low-VOC sealer; environmentally responsible quarry sourcing.

1.2 SPECIFIED ITEMS

A. Amphitheater Seating:

1. Horizontal top slab: smooth finish, thickness as described in drawings.
2. Vertical face veneer: split finish, thickness as described in drawings, set in mortar bed as indicated on drawings.

B. Free-standing Linear Bench:

1. Top slab: smooth finish, dimensions as shown on drawings.
2. Edge pieces: split-face finish, pinned to steel framing; lengths as shown in drawings.
3. Grout only around pin locations unless indicated otherwise.

C. Built-in Seating at Curved Plaza Wall:

1. Stone tops and edges: smooth or split finish as indicated; thickness and length per drawings.
2. Pinned to steel framing; grout only at pins unless otherwise noted.

D. Mortar/Adhesive: ASTM C270 Type S or approved exterior-grade adhesive where indicated.

1.3 FINISH

A. Stone Finishes:

1. Veneer (vertical faces): split-face.
   a. Weight of adhered stone veneer units shall not exceed 15 pounds per square foot.
2. Horizontal tops: Sawn/machine-cut or fine sandblasted with slip-resistant surface.
   a. Finish: Honed — Sawn/machine-cut or fine sandblasted — sandstone shall have a uniform, fine-textured surface suitable for pedestrian traffic and seating.

b. Texture: Smooth to the touch while providing adequate slip resistance for wet conditions; free of sharp projections, excessive surface roughness, saw ridges, or other conditions that could cause discomfort when used for seating or hand contact.
c. Sheen: Low-luster, non-reflective matte surface.
d. Slip Resistance: Provide a slip-resistant surface suitable for exterior pedestrian use. Submit manufacturer's/test laboratory documentation demonstrating compliance with applicable accessibility requirements for slip resistance.

3. Edge pieces: split-face as shown on drawings.

B. Hardware:

1. Stainless steel; polished or passivated.
2. Concealed where possible; exposed portions smooth and free of burrs.

1.4 FABRICATION

A. Fabricate units to required size, shape, and finish as indicated in drawings.

B. Drill or recess for pins or anchors as required.

C. Maintain uniform finish and edge profiles for top slabs, vertical veneers, and edge pieces.

1.5 TOLERANCES

A. Thickness ± 1/8".

B. Length ± 1/8".

C. Square ± 3/16".

D. Plane variation: 1/8".

E. Offset between connecting members: 1/4" max.

PART 2 - EXECUTION

2.1 INSTALLATION

A. Shop drawings: The cut stone manufacturer shall provide typical setting drawings and anchor details in conjunction with hardware manufacturer from the Owner Representative contract documents. These documents shall:

1. Show in elevation or plan the typical location of the cut stone at each of the typical conditions shown in the Owner Representative's plans.
2. Show in elevation or section the location of the basic component number and provide a key to abbreviations.
3. Show the type and location of anchors.

4. Show typical layout at corners, joints and finish details.
5. Commence lead time upon approval.
6. The cut stone manufacturer, in conjunction with the attachment hardware manufacturer, shall be responsible for the design of all connections and shall prepare and submit for approval shop drawings of typical anchor locations.

B. Setting of Cut Stone

1. Inspection:
   a. The contractor shall review and verify that the anchors, devices, and openings are ready to receive work under this section.
   b. Beginning of work of installation means acceptance of the conditions unless written exception is taken.
   c. Cut stone materials shall be reviewed before installation to determine acceptability as the cut stone manufacturer is not responsible for rejected pieces after the material has been installed.
2. Preparation:
   a. Provide and maintain temporary bracing that does not adversely affect the finish of the cut stone. Remove when material has set.
3. Seal all stone units on exposed surfaces with a clear, penetrating, breathable sealer compatible with the stone type, approved by the Landscape Architect prior to installation.
4. Installation:
   a. All cut stone shall be set by experienced masons accurately and in accordance with the shop drawings and layout.
   b. Non-load-bearing cut stone shall be properly mortared and anchored in place, with joints left open to receive grout.
      1) Apply stone veneer in compliance with Section 13.3 of TMS 402. The weight of adhered masonry units shall not exceed 15 pounds per square foot.
   c. Setting contractor shall furnish anchors, dowels and other anchoring devices and shims as may be required to erect the cut stone specified in these documents.
5. Erection Tolerances:
   a. Variation for plane may be 1/8".
   b. Offset from true alignment between two connecting members may be 1/4" maximum.
   c. No terminus piece of stone may be cut to a length equal to less than the length/2. If a smaller piece is required, use the following formula: Find (Y); the total length of the last two (2) pieces in a run. Divide (Y) by two (2) to find X (Y/2=X). Cut these two pieces to dimension X (after making allowances for grout, etc.).

6. Patching, Cleaning, Grouting and Finish Coat of Sealer:
   a. The repair of chipped or damaged cut stone or the sealed finish shall be the responsibility of the setting contractor after the acceptance of the product from the cut stone manufacturer. Product damaged in shipment shall be reported on the arrival at the jobsite. Failure to do this indicates acceptance.

      1) All repair of this type is to be done by mechanics skilled in this type of work, with the materials furnished by the cut stone manufacturer, and performed in accordance with his instruction.
   b. Cleaning shall be performed using a fiber brush and clear water with a sealer recommended by the sealing manufacturer once the sealer has been selected by the Owner's Representative in the sample approval process.

c. Apply a final coat of approved sealer after all patching, grouting and cleaning has been completed.

END OF SECTION

SECTION 050513 – SHOP-APPLIED COATINGS FOR METAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Heat-cured powder coating systems on metal substrates.

B. Related Sections:
1. Section 055000 "Metal Fabrications."

1.2 ACTION SUBMITTALS

A. Product Data: For each type of coating product specified.

B. Samples for Verification: For each color and substrate.
1. Clear Powder Coat Sheen Selection: Provide 12 inch x 12 inch clear powder coat samples in matte to semi-gloss finishes. The least reflective sheen available without producing a hazy or milky or white layer on the finish is desirable.

C. Coating Touch-Up Procedures: Submit coating manufacturer's recommended touch-up procedures and instructions.

D. Contract Closeout Submittal: Submit warranty at time of Project Closeout.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional applicator.

1.4 QUALITY ASSURANCE

A. Applicator Qualifications: Coating manufacturer's approved applicator equipped and trained for application of coatings, and approved to provide warranty specified.

1.5 DELIVERY, STORAGE & HANDLING

A. Deliver, unload, and store coated items so that they remain free of damage and deformation. Package and protect items during shipping and handling. Protect stored items from water. Keep coated items out of contact with materials that may adversely affect the coating

B. As required by SMACNA Guideline Chapter 3.

1.6 COORDINATION

A. Coordinate substrates and shop-applied coating systems. Where items are indicated to match coatings selected for other items, adjust formulations as required to achieve match.

PART 2 - PRODUCTS

2.1 CLEAR POWDER COATING

A. Description: Thermoset clear polyester powder coating.

B. Basis of Design: SRSF 90299 Super Clear by IFS Coatings, Inc.
1. Or equal.

C. Performance Criteria:
1. Hardness ASTM D3363: 2H-3H
2. Flexibility (ASTM D-1737-89): 1/8 inch
3. Adhesion ASTM D3359: 5b (100%).
4. Impact Direct/Indirect ASTM D2794: 120 in-lbs
5. Durability: Excellent.
6. Chemical Resistance : Very Good

D. Features:
1. Film Thickness: 1.8+ mil.
2. Sheen: As selected through sampling.

2.2 ACCESSORIES

A. All accessory materials required to comply with CARB for Paints and Coatings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify products have been stored, and will be installed, in accordance with project's Construction Indoor Air Quality Management Plan specified in Section 015721 - Indoor Air Quality Control

B. Verify existing conditions meet the manufacturer's requirements before starting work.

3.2 PREPARATION

A. Prepare surfaces to receive work in accordance with manufacturer's instructions.

3.3 INSTALLATION

A. General: Install all materials in accordance with manufacturer's instructions based on conditions present.

3.4 CLEAR POWDER COATINGS APPLICATION

A. Raw Steel Powder Coatings: Hand clean steel with thinner or MEK; preheat steel to bake out oils and impurities previous to applying clear powder.

B. Application: Clear powder coat to be final finish on raw steel; apply for this condition, according to manufacturer's written instructions.

C. Cure according to manufacturer's written instructions.

3.5 CLEANING

A. Dispose of all waste material in accordance with Section 017419 - Construction Waste Management and Disposal and project's Waste Management Plan.

3.6 SCHEDULE

A. Clear Powder Coat:
   1. Locations: As indicated.
      a. Misc Interior Metal Trims/Reveals
      b. Interior Metal Desk Panels

END OF SECTION

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Ferrous and non-ferrous metalwork detailed on the drawings as a component part of other assemblies, but not specified elsewhere.
2. Miscellaneous steel framing and supports including:
   a. Overhead doors.
   b. Mechanical and electrical equipment.
   c. Applications where framing and supports are not specified in other Sections.
3. Metal ladders.
4. Metal pipe crossovers.
5. Metal reception desk elements.

B. Related Sections:
1. Section 064023 “Interior Architectural Woodwork” for additional reception desk elements and requirements.
2. Section 074213.13 “Formed Metal Wall Panels” for mechanical equipment screens.
3. Section 220529 “Hangers and Supports for Plumbing.”
4. Section 260529 “Hangers and Supports for Electrical Systems.”

1.2 ACTION SUBMITTALS

A. Product Data: For the following:
1. Shop primers.
2. Shrinkage-resisting 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.

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. 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Provide metal fabrications capable of withstanding the effects of earthquake motions determined according to ASCE/SEI 7.

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications 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 A36/A36M.

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

B. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329/F2329M.

C. Post-Installed Anchors: Torque-controlled expansion anchors.
1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F593, and nuts, ASTM F594.

2.4 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 099100 "Painting."

B. Zinc-Rich Primer: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

C. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

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.

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.

C. Fasteners: Exposed, stainless steel.

2.7 METAL LADDERS

A. General:
1. Comply with ANSI A14.3, except for elevator pit ladders.
2. For elevator pit ladders, comply with ASME A17.1/CSA B44.

B. Steel Ladders: Constructed and installed to meet OSHA #1926.
   1. Space siderails 18 inches apart unless otherwise indicated.
   2. Siderails: Continuous, 3/8-by-2-1/2-inch steel flat bars, with eased edges.
   3. Rungs: 3/4-inch- diameter, steel bars.
   4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
   5. Provide nonslip surfaces on top of each rung.
   6. Clearance between ladder rungs and obstruction behind ladder:
      a. 7 inches (4-1/2 inches at elevator pit ladders)

2.8 METAL PIPE CROSSOVERS

A. Provide metal pipe crossovers where indicated. Fabricate of open-type construction with channel or plate stringers and pipe and tube railings unless otherwise indicated. Provide brackets and fittings for installation.
   1. Basis-of-Design Product: Cotterman; Steel Crossover Bridge.
   2. Fabricate pipe crossovers, including railings from steel.
   3. Fabricate treads and platforms from steel diamond plate floor plate.
   4. Comply with applicable railing requirements in Section 055213 "Pipe and Tube Railings."
   5. Provide minimum 36 by 36 inch walkpads at contact points between crossover feet and roofing system.
   6. Fasten or brace to the face of the parapet only, if required.

B. Galvanize exterior steel pipe crossovers, including treads, railings, brackets, and fasteners.

2.9 GENERAL FINISH REQUIREMENTS

A. Finish metal fabrications after assembly.

2.10 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
   1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
   1. Shop prime with primers specified in Section 099100 "Painting" unless otherwise indicated.

D. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
   1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
   2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
   3. Items Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
   4. Other Steel Items: SSPC-SP 3, "Power Tool Cleaning."

E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

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 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

A. 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 overhead doors securely to, and rigidly brace from, building structure.

C. Anchor shelf angles securely to existing construction.

3.3 REPAIRS

A. Touchup Painting:
1. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099100 " Painting."

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M, in accordance with Annex A1 zinc solder or Annex A3 metallizing. Repair method in accordance with Annex A2 galvanizing repair paint not permitted.

END OF SECTION

SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Steel pipe and tube railings.

1.2 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.

D. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E894 and ASTM E935.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. 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. 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 predrilled hole for exposed bolt anchorage and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.

2.3 STEEL AND IRON

A. Tubing: ASTM A500 Grade A (cold formed) or ASTM A513.

B. Pipe: ASTM A53/A53M, 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.

C. Plates, Shapes, and Bars: ASTM A36/A36M.

2.4 FASTENERS

A. General: Provide the following:
   1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B633 or ASTM F1941, 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 A153/A153M or ASTM F2329 for zinc coating.

B. Post-Installed Anchors: Torque-controlled expansion 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 E488/E488M, conducted by a qualified independent testing agency.
   1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
   2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F593, and nuts, ASTM F594.

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Etching Cleaner for Galvanized Metal: Complying with MPI#25.

C. Zinc-Rich Primer: 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 099100 "Painting."

E. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.6 FABRICATION

A. 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.

B. Form work true to line and level with accurate angles and surfaces.

C. 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.

D. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

E. Form changes in direction by bending or by inserting prefabricated elbow fittings.

F. 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.

G. Close exposed ends of railing members with prefabricated end fittings.

H. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.

I. 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.

2.7 STEEL AND IRON FINISHES

A. Galvanized Railings:
   1. Hot-dip galvanize exterior steel railings, including hardware, after fabrication.
   2. Comply with ASTM A123/A123M for hot-dip galvanized railings.
   3. Comply with ASTM A153/A153M for hot-dip galvanized hardware.

B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

C. Powder-Coat Finish for Galvanized Metal: Prepare, treat, and coat galvanized metal to comply with resin manufacturer's written instructions and as follows:
   1. Prepare galvanized metal by thoroughly removing grease, dirt, oil, flux, and other foreign matter.
   2. Treat prepared metal with zinc-phosphate pretreatment, rinse, and seal surfaces.

3. Apply thermosetting polyester or acrylic urethane powder coating with cured-film thickness of not less than 1.5 mils (0.04 mm).
4. Color: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. 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.

B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

3.2 ATTACHING RAILINGS

A. 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 wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.

3.3 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.
1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A780/A780M, in accordance with Annex A1 zinc solder or Annex A3 metallizing. Repair method in accordance with Annex A2 galvanizing repair paint not permitted.

END OF SECTION

SECTION 056000 – LANDSCAPE METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section describes the requirements for furnishing and installing metal fabrications made from steel shapes, plates, bars, strips, tubes, pipes and castings not a part of structural steel or specified in other Sections, including but not limited to the following items:
   1. Exterior steel shapes, as shown on drawings.
   2. Custom seats at plaza. (Painted 304 Stainless Steel - Framing, Brackets, Armrests, Backrests, and Panels)
   3. Curved Painted 304 Stainless Steel Panel Curtain at Wood Decks.
   4. Painted 304 Stainless Steel edging at paving edge adjacent to wood decks.

B. Related Sections:
   1. Section 06 15 33 "Wood Decking" for additional requirements for curved metal edge panels at Wood Decks.
   2. Section 09 91 00 "Painting And Coating" for field paint over stainless steel. Field paint/coating system T.B.D.
   3. Section 04 40 00 "Stone Assemblies" for custom seats.
   4. Section 06 15 33 "Wood Decking" for custom seats.

1.2 ACTION SUBMITTALS

A. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

1.3 COORDINATION WITH CUSTOM SEATING ASSEMBLIES

A. Coordinate fabrication and installation of metal framing components that are part of the custom seating assemblies with LandscapeForms Studio 431 or approved equal (EQ).

B. Ensure compatibility of metal framing dimensions, anchorage, and finish with adjacent stone and wood components.

C. Steel, Wood, and Stone Shop Drawings to be coordinated and submitted at the same time for review and approval.

D. Coordinate with the following sections for complete seating assembly:
   1. Section 04 40 00 – Stone Assemblies
   2. Section 06 15 33 – Wood Decking

PART 2 - PRODUCTS

2.1 PRODUCTS

A. FERROUS METALS
   1. General: For fabrication of metal work which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names and roughness.
   2. Steel Plates, Shapes and Bars: ASTM A36.

3. Steel Tubing: Cold-formed, ASTM A500 or hot rolled, ASTM A501; 0.125-inch thick wall thickness unless otherwise indicated.
4. Structural Steel Sheet: Hot rolled, ASTM A570; or cold rolled ASTM A611, Class 1.
5. Galvanized Structural Steel Sheet: ASTM A653, galvanized in accordance with ASTM A525, G90 coating designation.
6. Steel Pipe: ASTM A53; type and grade selected by fabricator; black finish unless galvanizing is indicated or specified; standard weight, schedule 40, unless otherwise indicated.
7. Gray Iron Castings: ASTM A48, Class 30.
8. Malleable Iron Castings: ASTM A47, grade selected by fabricator.

B. STAINLESS STEEL
1. All exposed exterior steel in landscape assemblies to be stainless steel unless otherwise noted on drawings. Finish to be determined by Landscape Architect.
   a. Tubing: ASTM A554.
   b. Pipe: ASTM A312.
   c. Castings: ASTM A743.
   d. Castings: ASTM A743.
   e. Plate: ASTM A167.

C. ALUMINUM
1. Aluminum Plate and Sheet: ASTM B209 (ASTM B209M), Alloy 6061-T6.

D. FASTENERS
1. Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A, with hex nuts, ASTM A563, and flat washers.
2. Machine Screws: ANSI B18.6.3.
3. Lag Bolts: ANSI B18.2.1.
4. Wood Screws: Flat head, carbon steel, ANSI B18.6.1.
5. Plain Washers: Round, carbon steel, ANSI B18.22.1.
6. Lock Washers: Helical, spring type, carbon steel, ANSI B18.21.1.
7. Expansion Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry and equal to 4 times the load imposed when installed in concrete, determined in accordance with ASTM E448.
8. Provide hot-dip galvanized fasteners at hot-dipped galvanized items.
9. Provide Type 304 stainless steel fasteners at interior stainless steel or aluminum items and Type 316 stainless steel fasteners at exterior stainless steel or aluminum items.

E. MISCELLANEOUS METAL FABRICATIONS

1. Loose Bearing and Leveling Plates: Provide for steel items bearing on masonry or concrete construction, made flat, free from warps or twists, and of required thickness and bearing area. Drill to receive anchor bolts and for grouting as required. Galvanize after fabrication.
2. Miscellaneous Framing and Supports:
   a. Provide miscellaneous framing and supports not a part of structural steel framework, as required to complete work.

b. Fabricate to sizes, shapes and profiles shown or required.
c. Fabricate from structural steel shapes and plates and steel bars of welded construction using mitered joints for field connection.
d. Cut, drill and tap units to receive hardware and similar items.
e. Furnish integrally welded anchors for casting into concrete or building into masonry.

3. Finish: Hot-dip galvanize exterior frames and supports, shop prime interior frames and supports in locations noted on drawings.

PART 3 - EXECUTION

3.1 PREPARATION

1. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors.

3.2 INSTALLATION

1. General:
   a. Fastening to In Place Construction: Provide threaded fasteners for concrete and masonry inserts, toggle bolts, through ¬bolts, lag bolts, wood screws and other connectors as required.
   b. Cutting, Fitting and Placement:
   c. Perform cutting, drilling and fitting required for installation of miscellaneous metal fabrications.
   d. Set work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels.
   e. Provide temporary bracing or anchors in formwork for items to be built into concrete, masonry or similar construction.
   f. Fit exposed connections together forming tight hairline joints.
   g. Weld connections not shop welded.
   h. Grind exposed joints smooth and imperceptible and touch up shop paint coat.
   i. Do not weld, cut or abrade the surfaces of exterior units which have been hot dip galvanized after fabrication, and intended for bolted or screwed field connections.
   j. Field Welding: Comply with AWS for procedures of manual shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work.
   k. Install prefabricated items in accordance with manufacturer's instructions.

END OF SECTION

SECTION 057300 - DECORATIVE METAL RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Steel and iron decorative railings.

1.2 COORDINATION AND SCHEDULING

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible.

B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver items to Project site in time for installation.

C. 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.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Manufacturer's product lines of railings assembled from standard components.
   2. Grout, anchoring cement, and paint products.

B. Shop Drawings: Include plans, elevations, sections, and attachment details.

C. Samples: For each type of exposed finish required.

D. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Product Options: Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics.
   1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval.

2.2 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. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
   1. Steel: 72 percent of minimum yield strength.

C. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
   1. Handrails and Top Rails of Guards:
      a. Uniform load of 50 lbf/ft. applied in any direction.
      b. Concentrated load of 200 lbf applied in any direction.
      c. Uniform and concentrated loads need not be assumed to act concurrently.
   2. Infill of Guards:
      a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
      b. Infill load and other loads need not be assumed to act concurrently.

2.3 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.

2.4 STEEL AND IRON

A. Tubing: ASTM A513.

B. Bars: Hot-rolled, carbon steel complying with ASTM A29/A29M, Grade 1010.

C. Plates, Shapes, and Bars: ASTM A36/A36M.

D. Perforated Metal: Cold-rolled steel sheet, ASTM A1008/A1008M, or hot-rolled steel sheet, ASTM A1011/A1011M, commercial steel Type B, 3/32 inchthick, with 1/4-inch holes 3/8 inch o.c. in staggered rows.

2.5 FASTENERS

A. Fastener Materials: Unless otherwise indicated, provide the following:
   1. Uncoated Steel Components: Plated-steel fasteners complying with ASTM B633, Class Fe/Zn 25 for electrodeposited zinc coating where concealed; Type 304 stainless steel fasteners where exposed.
   2. Dissimilar Metals: Type 304 stainless steel fasteners.

B. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193.
   1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
   2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F593, and nuts, ASTM F594.

2.6 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. 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, but not less than that required to support structural loads.

B. Connections: Fabricate railings with welded or nonwelded connections unless otherwise indicated.

C. 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. 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.

D. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

E. Form changes in direction by bending or by inserting prefabricated elbow fittings.

F. 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.

G. Close exposed ends of hollow railing members with prefabricated end fittings.

H. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.

I. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

J. Perforated-Metal Infill Panels: Fabricate infill panels from perforated metal made from steel.

2.8 STEEL AND IRON FINISHES

A. Powder-Coat Finish: Prepare, treat, and coat nongalvanized ferrous metal to comply with resin manufacturer's written instructions and as follows:
1. Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

Revise first subparagraph below to zinc-phosphate pretreatment if required.Treat prepared
metal with iron-phosphate pretreatment, rinse, and seal surfaces.
3. Apply thermosetting polyester or acrylic urethane powder coating with cured-film thickness not less than 1.5 mils (0.04 mm).
4. Color: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

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. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
2. 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. Anchor posts to metal surfaces with flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members.

E. Attach handrails to walls with wall brackets.

1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

F. Secure wall brackets to building construction as follows:
1. For wood stud partitions, use hanger or lag bolts set into wood backing between studs. Coordinate with carpentry work to locate backing members.

3.2 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood products.
2. Wood-preservative-treated lumber.
3. Dimension lumber framing.
4. Miscellaneous lumber.
5. Plywood backing panels.

B. Related Requirements:

1. Section 061600 "Sheathing" for sheathing, subflooring, and underlayment.
2. Section 230050 “Basic Mechanical Materials and Methods” for additional requirements for mechanical wood framed curbs.

1.2 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. Lumber grading agencies, and abbreviations used to reference them, include the following:

1. NeLMA: Northeastern Lumber Manufacturers' Association.
2. NLGA: National Lumber Grades Authority.
3. SPIB: The Southern Pine Inspection Bureau.
4. WCLIB: West Coast Lumber Inspection Bureau.
5. WWPA: Western Wood Products Association.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

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 in accordance with ASTM D5664.
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.

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates:

1. 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.
2. For preservative-treated wood products. Indicate type of preservative used and net amount of preservative retained.

1.5 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

A. Lumber: Comply with 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 or omit grade stamp and provide certificates of grade compliance issued by grading agency.
3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry wood products.

B. Maximum Moisture Content:

1. Boards: 15 percent.

2. Dimension Lumber: 15 percent unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1, Use categories as follows:

1. UC1: Interior construction not in contact with ground or subject to moisture. Include all rough carpentry.

    a. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.
    b. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
    c. Wood floor plates that are installed over concrete slabs-on-grade.
    d. Wood furniture.
    e. Wood millwork.

2. UC2: Interior construction not in contact with ground but may be subject to moisture. Include all rough carpentry.

    a. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.
    b. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
    c. Wood floor plates that are installed over concrete slabs-on-grade.
    d. Wood millwork.
    e. Wood flooring.

3. UC3A (Commodity Specification A): Coated sawn products in exterior construction not in contact with ground but exposed to all weather cycles including intermittent wetting. Include all rough carpentry.

    a. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
    b. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.
    c. Wood siding and trim.

4. UC3A (All Other Commodity Specifications): Coated products excluding sawn products in exterior construction not in contact with ground, exposed to all weather cycles but protected from liquid water. Include all rough carpentry.

    a. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
    b. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.
    c. Wood floor plates that are installed over concrete slabs-on-grade.

d. Wood siding and trim.
e. Wood sheathing.

5. UC3B (Commodity Specification A): Uncoated sawn products in exterior construction not in contact with ground, exposed to all weather cycles including intermittent wetting but with sufficient air circulation for wood to dry. Excludes sawn products not in contact with ground but with ground contact-type hazards. Include all rough carpentry.

   a. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
   b. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.
   c. Wood decking, railings, and joists and beams for decks that are not critical to the performance and safety of the entire system/construction and that are in locations easily accessible for maintenance, repair, or replacement.

6. UC3B (All Other Commodity Specifications): Uncoated products excluding sawn products in exterior construction not in contact with ground, exposed to all weather cycles including prolonged wetting. Include all rough carpentry.

   a. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
   b. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.

7. UC4A (Commodity Specification A): Non-critical sawn products in contact with ground and exposed to all weather cycles including continuous or prolonged wetting, and sawn products not in contact with ground but with ground contact-type hazards or that are critical or hard to replace. Include [all rough carpentry.] [the following items:]

   a. Wood framing members that are less than 6 inches above the ground.
   b. Joists and beams when they are difficult to maintain, repair, or replace and are critical to the performance and safety of the entire system/construction.

8. UC4A (All Other Commodity Specifications): Non-critical products excluding sawn products in contact with ground and exposed to all weather cycles, normal exposure conditions. Include all rough carpentry.
9. UC4B (Commodity Specification A): Critical or difficult-to-replace sawn products in contact with ground and exposed to all weather cycles including continuous or prolonged wetting, high decay potential, and salt water splash. Include all rough carpentry.

   a. Wood foundations.

10. UC4B (All Other Commodity Specifications): Critical or difficult-to-replace

products excluding sawn products in contact with ground and exposed to all weather cycles including high decay potential and salt water splash. Include all rough carpentry.

11. UC4C (Commodity Specification A): Critical structural sawn products in contact with ground and exposed to all weather cycles including continuous or prolonged wetting, severe environments, and extreme decay potential. Include all rough carpentry.

    a. Wood foundation piling.

12. UC4C (All Other Commodity Specifications): Critical structural products excluding sawn products in contact with ground and exposed to all weather cycles including severe environments and extreme decay potential. Include all rough carpentry.

    a. Wood foundation piling.

13. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
14. For exposed items indicated to receive a stained or natural finish, chemical formulations are not to 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.

    1. Where preservative-treated wood is used in enclosed locations where drying in service cannot readily occur, such wood shall be at a moisture content of 19 percent or less before being covered with insulation, interior wall finish, floor covering or other materials.

C. Identification:

    1. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

        a. Identification of treating manufacturer.
        b. Type of preservative used.
        c. Minimum preservative retention (pcf).
        d. End use for which the product is treated.
        e. AWPA standard to which the product was treated.
        f. Identity of the accredited inspection agency.

    2. 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, and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.
5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 DIMENSION LUMBER FRAMING

A. Non-Load-Bearing Interior Partitions by Grade: Construction or No. 2 grade.

1. Application: Interior partitions not indicated as load bearing.
2. Species:

a. Hem-fir (north); NLGA.
b. Southern pine or mixed southern pine; SPIB.
c. Spruce-pine-fir; NLGA.
d. Hem-fir; WCLIB, or WWPA.
e. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
f. Northern species; NLGA.
g. Eastern softwoods; NeLMA.
h. Western woods; WCLIB or WWPA.

B. Load-Bearing Partitions by Grade: No. 2 grade.

1. Application: Exterior walls and interior load-bearing partitions.
2. Species:

a. Douglas fir-larch; WCLIB or WWPA.

C. Ceiling Joists: Construction or No. 2 grade.

1. Species:

a. Hem-fir (north); NLGA.
b. Southern pine; SPIB.
c. Douglas fir-larch; WCLIB or WWPA.
d. Douglas fir-larch (north); NLGA.
e. Southern pine or mixed southern pine; SPIB.
f. Spruce-pine-fir; NLGA.
g. Hem-fir; WCLIB or WWPA.
h. Douglas fir-south; WWPA.
i. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
j. Northern species; NLGA.
k. Eastern softwoods; NeLMA.
l. Western woods; WCLIB or WWPA.

D. Joists, Rafters, and Other Framing by Grade: No. 2 grade.

1. Species:

    a. Douglas fir-larch; WCLIB or WWPA.

2.4 MISCELLANEOUS LUMBER

A. 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. Grounds.
7. Utility shelving.

B. Dimension Lumber Items: Construction or No. 2 grade lumber of any species.

1. Hem-fir (north); NLGA.
2. Mixed southern pine or southern pine; SPIB.
3. Spruce-pine-fir; NLGA.
4. Hem-fir; WCLIB or WWPA.
5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
6. Western woods; WCLIB or WWPA.
7. Northern species; NLGA.
8. Eastern softwoods; NeLMA.

C. Utility Shelving: Lumber with 15 percent maximum moisture content of any of the following species and grades:

1. Eastern white pine, Idaho white, lodgepole, ponderosa, or sugar pine; Premium or No. 2 Common (Sterling) grade; NeLMA, NLGA, WCLIB, or WWPA.
2. Mixed southern pine or southern pine; No. 2 grade; SPIB.
3. Hem-fir or hem-fir (north); Select Merchantable or No. 1 Common grade; NLGA, WCLIB, or WWPA.
4. Spruce-pine-fir (south) or spruce-pine-fir; Select Merchantable or No. 1 Common grade; NeLMA, NLGA, WCLIB, or WWPA.

D. Concealed Boards: 15 percent maximum moisture content and any of the following species and grades:

1. Mixed southern pine or southern pine; No. 2 grade; SPIB.
2. Hem-fir or hem-fir (north); Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
3. Spruce-pine-fir (south) or spruce-pine-fir; Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
4. Eastern softwoods; No. 2 Common grade; NeLMA.
5. Northern species; No. 2 Common grade; NLGA.
6. Western woods; Construction or No. 2 Common grade; WCLIB or WWPA.

E. Roofing Nailers: Structural- or No. 2-grade lumber or better; kiln-dried Douglas fir, southern pine, or wood having similar decay-resistant properties.

F. 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.

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.

2.5 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C in thickness indicated or, if not indicated, not less than 1/2-inch nominal thickness.

2.6 FASTENERS

A. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches into wood substrate.

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 A153/A153M or ASTM F2329.
2. For redwood, use hot-dip galvanized-steel fasteners.

B. Nails, Brads, and Staples: ASTM F1667.

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 or as appropriate for the substrate.

2.7 METAL FRAMING ANCHORS

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. MiTek Industries, Inc.
2. Simpson Strong-Tie
3. Tamlyn

B. Post Bases: Adjustable-socket type for bolting in place with standoff plate to raise post 1 inch above base and with 2-inch- minimum side cover, socket 0.062 inch thick, and standoff and adjustment plates 0.108 inch thick.

C. Joist Ties: Flat straps, with holes for fasteners, for tying joists together over supports.

1. Width: 3/4 inch.
2. Thickness: 0.050 inch.
3. Length: 16 inches.

D. Rafter Tie-Downs: Bent strap tie for fastening rafters or roof trusses to wall studs below, 1-1/2 inches wide by 0.050 inch thick. Tie fastens to side of rafter or truss, face of top plates, and side of stud below.

E. Rafter Tie-Downs (Hurricane or Seismic Ties): Bent strap tie for fastening rafters or roof trusses to wall studs below, 2-1/4 inches wide by 0.062 inch thick. Tie fits over top of rafter or truss and fastens to both sides of rafter or truss, face of top plates, and side of stud below.

F. Floor-to-Floor Ties: Flat straps, with holes for fasteners, for tying upper floor wall studs to band joists and lower floor studs, 1-1/4 inches wide by 0.050 inch thick by 36 inches long.

G. Hold-Downs: Refer to structural drawings.

H. Wall Bracing:

1. T-shaped bracing made for letting into studs in saw kerf, 1-1/8 inches wide by 9/16 inch deep by 0.034 inch thick with hemmed edges.
2. Angle bracing made for letting into studs in saw kerf, 15/16 by 15/16 by 0.040 inch thick with hemmed edges.

I. Materials: Unless otherwise indicated, fabricate from the following materials:

1. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 coating designation.

a. Use for interior locations unless otherwise indicated.

2. Heavy-Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M; 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.

a. Use for wood-preservative-treated lumber and where indicated.

3. Stainless steel bars and shapes complying with ASTM A276/A276M, Type 316.

a. Use for exterior locations and where indicated.

2.8 MISCELLANEOUS MATERIALS

A. Sill-Sealer Gaskets:

1. Closed-cell neoprene foam, **1/4 inch** thick, selected from manufacturer's

standard widths to suit width of sill members indicated.

B. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.

1. Adhesives shall have a VOC content of **70** g/L or less.
2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
4. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
5. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
6. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

C. 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

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Set work 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, and similar supports to comply with requirements for attaching other construction.

C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels.

D. Install metal framing anchors to comply with manufacturer's written instructions. Install

fasteners through each fastener hole.

E. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.

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. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

L. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.10.1, "Fastening Schedule," in California Building Code (CBC).
2. ICC-ES evaluation report for fastener.

M. Securely attach roofing nailers to substrates by anchoring and fastening to withstand bending, shear, or other stresses imparted by Project wind loads and fastener-resistance loads as designed in accordance with ASCE/SEI 7 and as indicated in the drawings.

N. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 INSTALLATION OF WOOD BLOCKING AND NAILERS

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 wood blocking to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

C. Attach wood roofing nailers securely to substrate to resist the designed outward and upward wind loads indicated on Drawings and in accordance with ANSI/SPRI ED-1, Tables A6 and A7.

D. 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 INSTALLATION OF WOOD FURRING

A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

B. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal- size furring vertically at 24 inches o.c.

C. Furring to Receive Gypsum Board or Plaster Lath: Install 1-by-2-inch nominal- size furring vertically at 16 inches o.c.

3.4 INSTALLATION OF WALL AND PARTITION FRAMING

A. General: Provide single bottom plate and double top plates using members of 2-inch nominal thickness whose widths equal that of studs, except single top plate may be used for non-load-bearing partitions. Fasten plates to supporting construction unless otherwise indicated.

1. For exterior walls, provide 2-by-6-inch nominal- size wood studs spaced 16 inches o.c. unless otherwise indicated.
2. For interior partitions and walls, provide 2-by-6-inch nominal- size wood studs spaced 16 inches o.c. unless otherwise indicated.
3. Provide continuous horizontal blocking at midheight of partitions more than 96 inches high, using members of 2-inch nominal thickness and of same width as wall or partitions.

B. Construct corners and intersections with three or more studs.

C. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Support headers on jamb studs.

1. For non-load-bearing partitions, provide double-jamb studs and headers not less than 4-inch nominal depth for openings 48 inches and less in width, 6-inch nominal depth for openings 48 to 72 inches in width, 8-inch nominal depth for openings 72 to 120 inches in width, and not less than 10-inch nominal depth for openings 10 to 12 feet in width.
2. For load-bearing walls, provide double-jamb studs for openings 60 inches and less in width, and triple-jamb studs for wider openings. Provide headers of depth indicated.

D. Provide diagonal bracing in exterior walls, at both walls of each external corner, at 45-degree angle, full-story height unless otherwise indicated. Use 1-by-4-inch nominal- size boards, let-in flush with faces of studs.

3.5 INSTALLATION OF FLOOR JOIST FRAMING

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, or 3 inches on masonry. Attach floor joists as follows:

1. Where supported on wood members, by toe nailing or 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. Anchor members paralleling masonry with 1/4-by-1-1/4-inch metal strap anchors spaced not more than 96 inches o.c., extending over and fastening to three joists. Embed anchors at least 4 inches into grouted masonry with ends bent at right angles and extending 4 inches beyond bend.

H. Provide solid blocking between joists under jamb studs for openings.

I. 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.

J. 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.

3.6 INSTALLATION OF CEILING JOIST AND RAFTER FRAMING

A. Ceiling Joists: Install with crown edge up and complying with requirements specified above for floor joists. Face nail to ends of parallel rafters.

1. Where ceiling joists are at right angles to rafters, provide additional short joists parallel to rafters from wall plate to first joist; nail to ends of rafters and to top plate, and nail to first joist or anchor with framing anchors or metal straps. Provide 1-by-8-inch nominal- size or 2-by-4-inch nominal- size stringers spaced 48 inches o.c. crosswise over main ceiling joists.

B. Rafters: Notch to fit exterior wall plates and toe nail or use metal framing anchors. Double rafters to form headers and trimmers at openings in roof framing, if any, and support with metal hangers. Where rafters abut at ridge, place directly opposite each other and nail to ridge member or use metal ridge hangers.

1. At valleys, provide double-valley rafters of size indicated or, if not indicated, of same thickness as regular rafters and 2 inches deeper. Bevel ends of jack rafters for full bearing against valley rafters.
2. At hips, provide hip rafter of size indicated or, if not indicated, of same thickness as regular rafters and 2 inches deeper. Bevel ends of jack rafters for full bearing against hip rafter.

C. Provide collar beams (ties) as indicated or, if not indicated, provide 1-by-6-inch nominal- size boards between every third pair of rafters, but not more than 48 inches o.c. Locate below ridge member, at third point of rafter span. Cut ends to fit roof slope and nail to rafters.

D. Provide special framing as indicated for eaves, overhangs, dormers, and similar conditions if any.

3.7 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.

END OF SECTION

SECTION 061533 – WOOD DECKING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Pedestal-Supported Wood decking at Courtyard.
2. Wood backrests on custom seats at plaza.

B. Related Sections:
1. Section 01 40 00, "Quality Requirements" for field sample mockup.
2. Section 03 10 00, "Concrete Forming" for wood deck foundation.
3. Section 03 20 00, "Concrete Reinforcing" for wood deck foundation.
4. Section 03 30 00, "Cast-In-Place Concrete" for wood deck foundation.
5. Section 06 10 00, "Rough Carpentry" for wood deck structural components.
6. Section 31 23 00, "Excavation and Fill" for wood deck foundation.
7. Section 04 40 00, "Stone Assemblies" for custom seats.
8. Section 05 60 00, "Landscape Metal Fabrications" for custom seats.
9. Section 32 93 00, "Landscape Planting" for Modular recessed tree grate system at tree well.

1.2 DEFINITIONS

A. Boards: Lumber of less than 2 inches nominal in thickness and 2 inches nominal or greater in width.

B. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.

C. Timber: Lumber of 5 inches nominal or greater in least dimension.

D. Lumber grading agencies, and the abbreviations used to reference them, include the following:
1. ALSC: American Lumber Standard Committee
2. NLGA: National Lumber Grades Authority.
3. WCLIB: West Coast Lumber Inspection Bureau.
4. WWPA: Western Wood Products Association.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. For preservative-treated wood products: Include chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.
2. For thermally modified wood decking and backrest boards: Provide product data indicating species, thermal modification process, mechanical properties, durability, and dimensional stability.
   a. Basis of Design Product: Thermally modified ash, Thermory® or approved equal.
3. For hidden wood decking clip system: Provide product data including material, coating, clip spacing, and fastener type.
   a. Basis of Design Product: Thermory® Hidden Clip System or approved equal.
4. For metal framing anchors: Include installation instructions.

B. Sustainable Design Submittals:
1. Lumber Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
2. Lumber Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

C. Shop Drawings:
1. Indicate location and size of each assembly; elevations of each type; and construction details not covered in Product Data, including the following:
2. Schedule and layout of wood decking, including joint patterns, board orientation, and attachment details.
3. Elevations and sections of deck assemblies, stairs, benches, and other components where wood decking or backrest boards are used.
4. Details of framing supports, edge conditions, transitions to adjacent materials, and concealed fastening systems.
5. Integration with adjacent concrete, metal framing anchors, and other work.

D. Maintenance Data:

1. Submit manufacturer’s maintenance instructions for wood deck finish, including recommended cleaning methods, preparation requirements, maintenance procedures, reapplication intervals, and coverage rates.
2. Include recommended inspection and maintenance schedule for maintaining appearance and performance of finished wood surfaces.
3. Furnish maintenance instruction and finish materials specified in Part 2 as part of close out submittals as applicable in Section 01 77 00 “Closeout Procedures”.
4. Deliver maintenance materials to Owner’s Representative at Project closeout. Do not deliver until acceptance by Owner’s Representative.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates:
1. For lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by ALSC's Board of Review.

B. Certificates of Inspection: Issued by lumber grading agency for exposed wood products not marked with grade stamp.

1.6 QUALITY ASSURANCE

A. Inspection: Prior to work of this Section, carefully inspect the installed work of other trades and verify that such work is completed to the point where this installation may properly commence.

B. Discrepancies: In the event of discrepancy, immediately notify the Owner's Representative. Do not proceed with installation in areas of discrepancy until such discrepancies have been fully resolved.

C. Lumber may be rejected by the Owner's Representative, whether or not it has been installed, for excessive warp, twist, bow, crook, mildew, fungus or mold, as well as for improper cutting and fitting.

D. Sample Mockup: Install or build field sample mockup to verify selections made under sample submittals, to confirm approved shop drawings, and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup using typical components, attachments to building structure, and methods of installation. Provide mockups at locations indicated by Owner's Representative.
2. If Owner's Representative determines mockups do not comply with requirements, reconstruct mockups until mockups are approved.
3. Approval of mockups does not constitute approval of deviations from the from the Contract Documents contained in mockups unless such deviations are specifically approved by Owner's Representative in writing.
4. Protect accepted mockups from the elements with weather-resistive membrane.
5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at the time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials under cover and protected from weather and contact with damp or wet surfaces. Stack lumber flat with spacers between each bundle to provide air circulation. Provide air circulation around stacks and under coverings.

B. Handle and store plastic lumber to comply with manufacturer's written instructions.

1.8 MOCK-UP

A. Provide a field sample mock-up in accordance with Section 01 40 00.

1.9 COORDINATION WITH CUSTOM SEATING ASSEMBLIES

A. Coordinate fabrication and installation of wood backrest components that are part of the custom seating assemblies with LandscapeForms Studio 431 or approved equal (EQ).

B. Ensure compatibility of wood backrest dimensions, finish, and attachment details with adjacent stone and metal components.

C. Steel, Wood, and Stone Shop Drawings to be coordinated and submitted at the same time for review and approval.

D. Coordinate with the following sections for complete seating assembly:
1. Section 04 40 00 – Stone Assemblies
2. Section 05 60 00 – Landscape Metal Fabrications

PART 2 - PRODUCTS

2.1 LUMBER, GENERAL

A. Comply with DOC PS 20 and with grading rules of lumber grading agencies certified by ALSC's Board of Review as applicable. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by ALSC's Board of Review.
1. Factory mark each item with grade stamp of grading agency.
2. For items that are exposed to view in the completed Work, omit grade stamp and provide certificates of grade compliance issued by grading agency.
3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry wood products.
4. Provide dressed lumber, S4S, unless otherwise indicated.

B. Certified Wood: Boards and dimension lumber shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and to FSC STD-40-004, "FSC Standard for Chain of Custody Certification."

C. Maximum Moisture Content:
1. Boards: 15 percent.
2. Dimension Lumber: 19 percent for 2-inch nominal thickness or less; 19 percent for more than 2-inch nominal thickness.

2.2 WOOD DECKING

A. Dimension Lumber Decking: Thermory® hardwood, 5/4x6 nominal (1.02" x 5.70" actual) and the following species:
1. Material: Thermally treated white ash. Class B fire rating.
2. Profile: D4 sg2
3. Distributor: Mount Storm Forest Products, 5700 Earhart Court, Windsor, CA 95492; Contact: Dan Everett - dan@mountstorm.com; ph.: 707.838.3177

2.3 WOOD BACKRESTS ON CUSTOM SEATS

A. Dimension Lumber for Benches: Thermory® hardwood, 2X4 nominal (1.65" x 3.5" actual).
   1. Material: Thermally treated white ash. Class B fire rating.
   2. Distributor: Mount Storm Forest Products, 5700 Earhart Court, Windsor, CA 95492 Contact: Dan Everett - dan@mountstorm.com, ph.: 1.707.838.3177

2.4 DIMENSION LUMBER FRAMING

A. Deck Framing: Any species and grade with a modulus of elasticity of at least 1,300,000 psi and an extreme fiber stress in bending of at least 850 psi for 2-inch nominal thickness and 12-inch nominal width for single-member use.

2.5 PRESERVATIVE TREATMENT

A. Pressure treat boards and dimension lumber with waterborne preservative according to AWPA U1; Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for posts and items in contact with the ground.

B. Preservative Chemicals: Acceptable to Authorities Having Jurisdiction.

C. Use process for dimension lumber that includes water-repellent treatment.

D. After treatment, redry dimension lumber to 19 percent maximum moisture content.

E. Mark treated wood with treatment quality mark of an inspection agency approved by ALSC's Board of Review.

F. Application: Treat all wood unless otherwise indicated. Do not treat Thermory® deck boards.

2.1 PEDESTAL SYSTEM

A. Adjustable deck supports designed to support concrete pavers:
   1. Manufacturer: Bison Innovative Products or equal.
   2. Contact: 2395 W 4th Ave, Denver, CO 80223. Toll Free 888-412-4766. Phone 303-628-7950. Fax 303-825-5988. www.BisonIP.com.

B. System Description:
   1. Furnish and install a complete adjustable deck support system with a maximum cavity height of up to 9 inches:
   2. Versadjust Adjustable Pedestals:
      a. Typical Height Range 1/8 inch – 9 inches.
      b. Design Capacity 1250 lbs/pedestal.
      c. Configurations:
         1) Model V1: 2 1/4 inches to 2-3/4 inches.

2) Model V2: 2-3/4 inches to 3-3/4 inches.

3) Model V3: 3-3/4 inches to 5-3/4 inches.

4) Model V4: 5 3/4 inches to 9 inches.

3. Joist Top Connectors:

a. Model JT: Joist Top Attachment.

b. Model JS: Joist Saddle Attachment.

4. Low Height Pedestal Supports:

a. Model VT316 1/8 inch tall.

b. Model HD25 Stackable (4 Max) 1/4 inch tall.

c. Model HD50 Stackable (4 Max) 1/2 inch tall.

d. Model HD75 Stackable (4 Max) 3/4 inch tall.

5. Shims:

a. Model B11 Flexible Shim 1/16 inch.

1) Use no more than 4 shims. If using only 1/4 segment, adhere it to the pedestal with construction adhesive.

b. Model PS1 Rigid Poly Shims 1/8 inch.

1) Use no more than 2 shims. If using only 1/4 segment, adhere it to the pedestal with construction adhesive.

2.2 METAL EDGE

A. As indicated on drawings.

2.3 FASTENERS

A. General: Provide fasteners of size and type indicated, acceptable to authorities having jurisdiction, and that comply with requirements specified in this article for material and manufacture. Provide screws, in sufficient length, to penetrate not less than 1-1/2 inches into wood substrate.
1. Use stainless steel unless otherwise indicated.
2. For pressure-preservative-treated wood, use stainless-steel fasteners.
3. For wood decking, use stainless-steel fasteners to secure Thermory® hidden clips.

B. Power-Driven Fasteners: ICC-ES AC70.

C. Stainless-Steel Bolts: ASTM F 593, Alloy Group 1 or 2 ; with ASTM F 594, Alloy Group 1 or 2 hex nuts and, where indicated, flat washers.

D. Post installed Anchors: Stainless-steel, torque-controlled expansion anchors with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when

installed in concrete as determined by testing according to ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Stainless-steel bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

2.4 METAL FRAMING ANCHORS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

B. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer that meet or exceed those indicated on Drawings. 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.

C. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G90 coating designation.

D. 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: 3-1/2 inches.
   2. Thickness: 0.062 inch.

2.5 CONCEALED DECKING FASTENERS

A. Deck Clips: Black-oxide-coated, stainless-steel clips designed to be fastened to deck framing with screws, and to secure decking material with teeth that also provide uniform spacing of decking material.
   1. Products: Subject to compliance with requirements, provide the following:
      a. Thermory® hidden clip deck system.

2.6 MAINTENANCE MATERIALS

A. Maintenance Finish:

   1. Product: Penofin TSH Hardwood Stain or equal.

   2. Furnish manufacturer's unopened, original containers clearly identified with product name, color, and application instructions.

B. Quantity: Provide not less than one gallon of maintenance finish. Quantities shall be sufficient to perform future touch-up and maintenance of completed wood deck surface.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

3.3 INSTALLATION, GENERAL

A. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit work to other construction; scribe and cope as needed for accurate fit.

B. Framing Standard: Comply with AF&PA WCD1 unless otherwise indicated.

C. Install wood decking with crown up (bark side down).

D. Stagger decking end joints in adjacent rows.

E. Secure decking to framing with deck clips.

F. Install metal framing anchors to comply with manufacturer's written instructions.

G. Do not splice structural members between supports unless otherwise indicated.

H. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

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 members or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

J. Apply copper naphthenate field treatment to comply with AWPA M4, to cut surfaces of preservative-treated lumber.

K. Securely attach exterior rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
1. "Fastening Schedule" in ICC's International Building Code.

L. Select fasteners of size that do not fully penetrate members where opposite side is exposed to view. Make tight connections between members. Install fasteners without splitting wood.

M. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced and with adjacent rows staggered.

3.4 ELEVATED DECK JOIST FRAMING INSTALLATION

A. General: Install 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, or 2 inches on masonry. Attach floor joists where framed into wood supporting members by using metal joist hangers. Do not notch joists.

B. Frame openings with headers and trimmers supported by metal joist hangers; double headers and trimmers where span of header exceeds 48 inches.

C. Provide solid blocking of 2-inch nominal thickness by depth of joist over supports.

D. Provide solid blocking of 2-inch nominal thickness by depth of joist at intervals of 96 inches o.c., between joists.

E. Install metal edge as indicated in drawings.

END OF SECTION

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. Subflooring.
4. Underlayment.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for plywood backing panels.
2. Section 061643 "Gypsum Sheathing" for gypsum wall sheathing.
3. Section 061656 "Air-Barrier Water-Resistant Sheathing System" for water-resistive sheathing applied over plywood wall sheathing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

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 a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.4 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For following products, from ICC-ES:

1. Preservative-treated plywood.
2. Fire-retardant-treated plywood.
3. Foam-plastic sheathing.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.6 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory."

2.2 WOOD PANEL PRODUCTS

A. Emissions: Products shall meet the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Certified Wood: For the following wood products, provide materials produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship":

1. Plywood.
2. Oriented strand board.
3. Fiberboard wall sheathing.
4. Particleboard underlayment.

5. Hardboard underlayment.

C. Plywood: DOC PS 1.

D. Oriented Strand Board: DOC PS 2.

E. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.

F. Factory mark panels to indicate compliance with applicable standard.

2.3 PRESERVATIVE-TREATED PLYWOOD

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

C. Application: Treat items indicated on Drawings.

2.4 WALL SHEATHING

A. Plywood Wall Sheathing: Per the Structural Drawings and General Notes.

2.5 ROOF SHEATHING

A. Plywood Roof Sheathing: Per the Structural Drawings and General Notes.

2.6 SUBFLOORING AND UNDERLAYMENT

A. Plywood Combination Subfloor-Underlayment: Per the Structural Drawings and General Notes.

1. Span Rating: Per the Structural Drawings and General Notes.
2. Nominal Thickness: Per the Structural Drawings and General Notes.
3. Edge Detail: Tongue and groove.
4. Surface Finish: Fully sanded face.

B. Plywood Subflooring: Per the Structural Drawings and General Notes.

1. Span Rating: Per the Structural Drawings and General Notes.
2. Nominal Thickness: Per the Structural Drawings and General Notes.

C. Underlayment, General: Provide underlayment in nominal thicknesses indicated or, if not indicated, not less than 1/4 inch over smooth subfloors and not less than 3/8 inch over board or uneven subfloors.

D. Plywood Underlayment for Resilient Flooring: DOC PS 1, Exterior A-C with fully sanded face.

E. Plywood Underlayment for Ceramic Tile: DOC PS 1, Exterior, C-C Plugged, not less than 5/8-inch nominal thickness.

F. Plywood Underlayment for Carpet: DOC PS 1, Exposure 1, Underlayment.

G. Hardboard Underlayment: ANSI A135.4, Class 4 (Service), Surface S1S; with back side sanded.

2.7 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

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.

1. For wall and roof sheathing panels, provide screws with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

1.2 MISCELLANEOUS MATERIALS

A. Adhesives for Field Gluing Panels to Framing: Formulation complying with APA AFG-01 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesives 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."

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. NES NER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in "California Building Code."

D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

E. Coordinate wall 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. Combination Subfloor-Underlayment:

a. Glue and nail to wood framing.
b. Screw to cold-formed metal framing.
c. Space panels 1/8 inch apart at edges and ends.

2. Subflooring:

a. Glue and nail to wood framing.
b. Screw to cold-formed metal framing.
c. Space panels 1/8 inch apart at edges and ends.

3. Wall and Roof Sheathing:

    a. Nail to wood framing.
    b. Screw to cold-formed metal framing.
    c. Space panels 1/8 inch apart at edges and ends.

4. Underlayment:

    a. Nail 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 HARDBOARD UNDERLAYMENT INSTALLATION

A. Comply with CPA's recommendations and hardboard manufacturer's written instructions for preparing and applying hardboard underlayment.

1. Fastening Method: Nail underlayment to subflooring.

END OF SECTION

SECTION 061643 - GYPSUM SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Exterior parapet under roofing, and soffit gypsum sheathing.

B. Related Sections:
1. Section 061656 "Air-Barrier Water-Resistant Sheathing System" for gypsum sheathing with integral air barrier and water-resistant barrier.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: As tested according to ASTM E119; 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.

2.2 GYPSUM SHEATHING

A. Gypsum Wall and Soffit Sheathing:
1. Glass-Mat Gypsum Sheathing: ASTM C1177/C1177M.
a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
1) CertainTeed Corporation; GlasRoc.
2) CertainTeed Gypsum; CertainTeed GlasRoc Type X Sheathing.
3) Continental Building Products, LLC; Weather Defense.
4) Georgia-Pacific Gypsum LLC; Dens-Glass Gold.
5) National Gypsum Company; Gold Bond eXP Sheathing.
6) USG Corporation; Securock.
b. Type and Thickness: Type X, 5/8 inch thick.

B. Gypsum Parapet Wall Sheathing: ASTM C1177/C1177M, glass-mat, water-resistant gypsum substrate, Type X, 5/8 inch thick, factory primed.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Georgia-Pacific Gypsum LLC; Dens Deck Prime.

2.3 FASTENERS

A. Screws for Fastening Sheathing to Wood Framing: ASTM C1002.

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. Coordinate 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.

D. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

3.2 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.
   1. Fasten gypsum sheathing to wood framing with screws.
   2. Install panels with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
   3. 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.

END OF SECTION

SECTION 061656 - AIR-BARRIER WATER-RESISTANT SHEATHING SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Exterior wall sheathing.
2. Sheathing joint and penetration treatment.
3. Vaper-permeable liquid applied flashing.

B. Related Sections:
1. Section 061643 "Gypsum Sheathing" for wall and parapet sheathing.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
1. Review air-barrier water-resistant gypsum sheathing system requirements and installation, special details, transitions, mockups, air-leakage testing, protection, and work scheduling that covers air-barrier water-resistant gypsum sheathing system.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
1. Include manufacturer's technical data and tested physical and performance properties of products.

B. Shop Drawings: For air-barrier and water-resistant glass-mat gypsum sheathing assemblies.
1. Show locations and extent of sheathing, accessories, and assemblies specific to Project conditions.
2. Include details for sheathing 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.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Field Quality-Control Reports: From manufacturer's representative.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer of air-barrier and water-resistant glass-mat gypsum sheathing.

B. Mockups: Build mockups to set quality standards for materials and execution.
   1. Build integrated mockups of exterior wall assembly, 150 sq. ft. (14 sq. m), incorporating backup wall construction, openings, typical 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.
   2. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.
   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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Air-Barrier and Water-Resistant Sheathing Performance: Air-barrier and water-resistant glass-mat gypsum sheathing 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, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits. Conform to ESR-3786.

2.2 MANUFACTURERS

A. Basis-of-Design System: Subject to compliance with requirements, provide the following:
   1. Georgia-Pacific Gypsum LLC.; DensElement Barrier System.

2.3 SHEATHING

A. Air-Barrier and Water-Resistant Glass-Mat Gypsum Sheathing: ASTM C1177/C1177M, Type X, coated fiberglass mat gypsum sheathing with integral weather-resistant barrier and air barrier complying with ASTM E2178.

1. Thickness: 5/8 inch thick.
2. Edges: Square.
3. Flashing and Transitions Strips: As acceptable to sheathing manufacturer.
4. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference when tested according to ASTM E2178.
5. Vapor Permeance: Minimum 20 perms when tested according to ASTM E96/E96M, Desiccant Method, Procedure A.

2.4 ACCESSORIES

A. Provide primers, transition strips, termination strips, joint reinforcing fabric and 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 sheathing 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.

2.5 FASTENERS

A. Screws for Fastening Sheathing to Wood Framing: ASTM C1002.

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. Coordinate 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.

D. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

3.2 SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.
1. Fasten gypsum sheathing to wood framing with screws.
2. Install panels with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
3. 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. Air-Barrier and Water-Resistant Glass-Mat Gypsum Sheathing System:
1. Install accessory materials according to sheathing manufacturer's written instructions and details to form a seal with adjacent construction, to seal fasteners, and ensure continuity of air and water barrier.
   a. Coordinate the installation of sheathing with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
   b. Install liquid applied transitions on roofing membrane or base flashing, so that a minimum of 3 inches of coverage is achieved over each substrate.
2. Connect and seal sheathing material continuously to air barriers specified under other Sections as well as 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.
3. 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.
4. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply fluid applied flashing, so that a minimum of 3 inches of coverage is achieved over each substrate. Maintain 3 inches of full contact over firm bearing to perimeter frames, with not less than 1 inch of full contact.
5. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, doors, and miscellaneous penetrations of sheathing material with foam sealant.
6. Seal top of through-wall liquid applied flashings to sheathing with an additional 6-inch- wide, transition.
7. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
8. Repair punctures, voids, and deficient applications in liquid applied flashings and liquid applied transitions extending 6 inches beyond repaired areas in strip direction or as recommended by manufacturer.

3.3 FIELD QUALITY CONTROL

A. Engage sheathing manufacturer's representative to prepare an observation report of air-barrier water-resistant gypsum sheathing system for verification of the following:
1. Continuity of air-barrier water-resistant sheathing system has been achieved.
2. Connections between air-barrier water-resistant sheathing system and other components, materials, and assemblies comply with manufacturer's recommended details.
3. All fastener heads have been sealed.

END OF SECTION

SECTION 061719 – CROSS-LAMINATED TIMBER

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings 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 all labor, materials, transportation, and services to complete the Cross-Laminated Timber (CLT) system.

B. Related Work:

1. Section 035216 "Lightweight Insulating Concrete" for topping and acoustic underlayment at occupied levels.
2. Section 061000 "Rough Carpentry".
3. Section 061800 "Glued-Laminated Construction".
4. Section 072100 "Thermal Insulation".
5. Section 099300 "Staining and Transparent Finishing" for finish for structural glued-laminated timber.

1.3 SUBMITTALS

A. Product data: submit product data for temporary weather protection plan and proprietary connectors.

B. Shop Drawings: submit detailed shop drawings of the CLT panels including panel thickness, dimensions, panel layup, and connection details. Shop drawings may take the form of paper drawings, electronic Computer Aided Drafting (CAD) files or a Building Information Model (BIM).

C. Samples: submit a 12" x 12" sample of CLT material.

1.4 QUALITY ASSURANCE

A. CLT panels shall comply with ANSI/APA PRG 320 Standard for Performance-Rated Cross-Laminated Timber.

B. Product marking: CLT panels shall be identified with a tag or stamp indicating layup, mill name, approved agency, and the symbol of ANSI/APA PRG 320.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Keep CLT panels dry and protected from damage during delivery and storage. Store off of the ground and covered.
B. Provide protection from moisture exposure prior to building enclosure dry-in.

PART 2 – PRODUCTS

2.1 CROSS-LAMINATED TIMBER

A. Moisture content: at the time of manufacturing, moisture content of lumber shall be 12% +/- 3%.

B. CLT Layup: V2.

C. Species:

a. Bottom Lamina: Douglas fir-larch.
b. Other lamina: Douglas fir-larch or spruce pine fir.

D. Appearance classification: Architectural.
a. An appearance classification normally suitable for applications where appearance is an important, but not overriding consideration. Specific characteristics of this classification are as follows:
i. In exposed surfaces, all knot holes and voids measuring over 3/4 in. (19 mm) are filled with a wood-tone filler or clear wood inserts selected for similarity with the grain and color of the adjacent wood.
ii. The face layers exposed to view are free of loose knots and open knot holes are filled.
iii. Knot holes do not exceed 3/4 in. (19 mm) when measured in the direction of the lamination length with the exception that a void may be longer than 3/4 in. (19 mm) if its area is not greater than 1/2 in. (323 mm).
iv. Voids greater than 1/16 in. (1.6 mm) wide created by edge joints appearing on the face layers exposed to view are filled.
v. Exposed surfaces are surfaced smooth with no misses permitted.

E. Sealer:
a. Penetrating Wood Sealer:
i. Provide Basis of Design or approved equal: Sansin KP-12 UVW.
ii. Factory apply at ends and surfaces of Architectural and Premium Class exposed to view in preparation for clear, transparent finish as specified under work of Section 09 9300 Staining & Transparent Finishing.
b. End Grain Sealer:
i. Provide Basis of Design or approved equal: Sansin End Seal or Hexion Cascowax EW-58A.
ii. Apply end grain sealer on all perimeter and interior panel edges where end grain laminations are exposed.

2.2 CONNECTORS

A. Screws: SWG ASSY SK by Wurth.

B. Panel anchors: by Simpson Strong-tie.

2.3 FABRICATION

A. CLT panels shall be fabricated in strict conformance to approved shop drawings. Fabrication prior to receipt of approved shop drawings shall be at the Contractor's risk.

B. CLT panels shall be fabricated to join tightly and in proper alignment.

PART 3 – EXECUTION

3.1 ERECTION

A. Field measure and verifying that the foundations and any structural framing that supports the CLT panels are in the correct location, alignment, and at the proper elevation. The Contractor shall not proceed with work until unsatisfactory conditions have been corrected in an acceptable manner. Commencement of erection implies acceptance of conditions.

B. The Contractor shall be responsible for all temporary shoring and bracing necessary to maintain the stability of the CLT system during erection.

END OF SECTION

SECTION 061800 - GLUED-LAMINATED CONSTRUCTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural glued-laminated timber.

a. Treatment for exterior columns.

2. Timber connectors.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for dimension lumber items associated with structural glued-laminated timber.
2. Section 061719 “Cross-Laminated Timber” for structural glued-laminated timber.
3. Section 099300 “Staining and Transparent Finishing” for finish for structural glued-laminated timber.

1.2 DEFINITIONS

A. Structural Glued-Laminated (Glulam) Timber: An engineered, stress-rated timber product assembled from selected and prepared wood laminations bonded together with adhesives and with the grain of the laminations approximately parallel longitudinally.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include data on lumber, adhesives, fabrication, and protection.
2. For preservative-treated wood products. Include chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.
3. For connectors. Include installation instructions.

B. Sustainable Design Submittals:

C. Shop Drawings:

1. Show layout of structural glued-laminated timber system and full dimensions of each member.
2. Indicate species and laminating combination.

3. Include large-scale details of connections.
4. Apply specified factory finish to three sides of half length of each Sample.

1.4 INFORMATIONAL SUBMITTALS

A. Certificates of Conformance: Issued by a qualified testing and inspecting agency indicating that structural glued-laminated timber complies with requirements in ANSI A190.1.

B. Material Certificates: For preservative-treated wood products, from manufacturer. Indicate type of preservative used and net amount of preservative retained.

C. Research/Evaluation Reports: For structural glued-laminated timber and timber connectors, from ICC-ES.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: An AITC- or APA-EWS-licensed firm.

B. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.

C. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

D. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

1.6 DELIVERY, STORAGE, AND HANDLING

A. General: Comply with provisions in AITC 111.

B. Individually wrap members using plastic-coated paper covering with water-resistant seams.

C. Provide protection from moisture exposure prior to building enclosure dry-in.

PART 2 - PRODUCTS

2.1 STRUCTURAL GLUED-LAMINATED TIMBER

A. General: Provide structural glued-laminated timber that complies with ANSI A190.1 and ANSI 117 or research/evaluation reports acceptable to authorities having jurisdiction.

1. Factory mark each piece of structural glued-laminated timber with AITC Quality Mark or APA-EWS trademark. Place mark on surfaces that are not exposed in the completed Work.
2. Provide structural glued-laminated timber made from single species.

3. Provide structural glued-laminated timber made from solid lumber laminations; do not use laminated veneer lumber.
4. Provide structural glued-laminated timber made with wet-use adhesive complying with ANSI A190.1.
5. Adhesives: Do not use adhesives that contain urea formaldehyde.
6. Adhesives: Use adhesives that meet the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Species and Grades: For beams.

1. Species and Beam Stress Classification: Douglas fir-larch, 24F-1.8E.
2. Lay-up: Either balanced or unbalanced.

C. Species and Grades for Columns:

1. Species and Combination Symbol: Douglas fir-larch, 1.

D. Appearance Grade: Architectural, complying with AITC 110.

E. Moisture Content: At time of fabrication not to exceed 12 percent.

2.2 PRESERVATIVE TREATMENT

A. Preservative Treatment: Where preservative-treated structural glued-laminated timber is indicated, comply with AWPA U1, Use Category 1, Category 2, Category 3A, Category 3B.

B. Preservative: One of the following:

1. For exterior glulam columns, use a preservative that fully penetrates the wood, does not alter the appearance of the wood, allows for application of stains and sealers, will not corrode fasteners, does not contain metals and will not damage structural glued-laminated columns:

a. Basis of Design: Permapost KLEAR-GARD 25 with TRU-CORE
b. Or equal.

2. Oxine copper (copper-8-quinolinolate) in a light petroleum solvent.
3. Pentachlorophenol in light petroleum solvent.
4. Copper naphthenate in a light petroleum solvent.
5. Ammoniacal zinc copper arsenate (ACZA) in a water solution.
6. Chromated copper arsenate (CCA) in a water solution.
7. Ammoniacal copper quat Type A (ACQ-C) in a water solution.
8. Propiconazole tebuconazole imidacloprid (PTI) in a water emulsion.

C. After dressing members, apply a copper naphthenate field-treatment preservative to comply with AWPA M4 to surfaces cut to a depth of more than 1/16 inch.

2.3 TIMBER CONNECTORS

A. Refer to structural general notes for timber connector requirements.

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. Simpson Strong-Tie Co., Inc.
2. USP Structural Connectors

C. Provide bolts, 3/4 inch unless otherwise indicated, complying with ASTM A307, Grade A; nuts complying with ASTM A563; and, where indicated, flat washers.

D. Materials: Unless otherwise indicated, fabricate from the following materials:

1. Structural-steel shapes, plates, and flat bars complying with ASTM A36/A36M.
2. Round steel bars complying with ASTM A575, Grade M 1020.
3. Hot-rolled steel sheet complying with ASTM A1011/A1011M, Structural Steel, Type SS, Grade 33.
4. Stainless steel flat bars complying with ASTM A666, Type 316.
5. Stainless steel bars and shapes complying with ASTM A276, Type 316.
6. Stainless steel plate, sheet, and strip complying with ASTM A240/A240M or ASTM A666, Type 316.

E. Hot-dip galvanize steel assemblies and fasteners after fabrication to comply with ASTM A123/A123M or ASTM A153/A153M.

2.4 MISCELLANEOUS MATERIALS

A. Penetrating Wood Sealer:

1. Provide Basis of Design or approved equal: Sansin KP-12 UVW.
2. Factory apply at ends and surfaces of Architectural and Premium Class exposed to view in preparation for clear, transparent finish as specified under work of Section 09 9300 Staining & Transparent Finishing.

B. End Grain Sealer:

1. Provide Basis of Design or approved equal: Sansin End Seal or Hexion Cascowax EW-58A.
2. Apply end grain sealer on all perimeter and interior panel edges where end grain laminations are exposed.

2.5 FABRICATION

A. Shop fabricate for connections to greatest extent possible, including cutting to length and drilling bolt holes.

1. Dress exposed surfaces as needed to remove planing and surfacing marks.
2. V-shaped Composite Section Columns: Fabricated in the shop as one composite

unit by glued-laminated timer fabricator.

B. Camber: Fabricate horizontal and inclined members of less than 1:1 slope with either circular or parabolic camber equal to 1/500 of span.

C. Where preservative-treated members are indicated, fabricate (cut, drill, surface, and sand) before treatment to greatest extent possible. Where fabrication must be done after treatment, apply a field-treatment preservative to comply with AWPA M4.

1. Use inorganic boron (SBX) treatment for members not in contact with the ground and continuously protected from liquid water.
2. Use copper naphthenate treatment for members in contact with the ground or not continuously protected from liquid water.

D. End-Cut Sealing: Immediately after end cutting each member to final length and after preservative treatment, apply a saturation coat of end sealer to ends and other cross-cut surfaces, keeping surfaces flood coated for not less than 10 minutes.

1. For KLEAR-GARD 25 treated members, no special end cut sealing is required.

E. Seal Coat: After fabricating, sanding, and end-coat sealing, apply a heavy saturation coat of penetrating sealer on surfaces of each unit except for preservative-treated wood where treatment included a water repellent.

2.6 FACTORY FINISHING

A. Semitransparent Stain Finish: Manufacturer's standard oil-based stain, resistant to mold and fungus.

1. Color: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates in areas to receive structural glued-laminated timber, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Erect structural glued-laminated timber true and plumb and with uniform, close-fitting joints. Provide temporary bracing to maintain lines and levels until permanent supporting members are in place.

1. Handle and temporarily support glued-laminated timber to prevent surface damage, compression, and other effects that might interfere with indicated

finish.

B. Cutting: Avoid extra cutting after fabrication. Where field fitting is unavoidable, comply with requirements for shop fabrication.

1. Where preservative-treated members must be cut during erection, apply a field-treatment preservative to comply with AWPA M4.

a. Use inorganic boron (SBX) treatment for members not in contact with the ground and continuously protected from liquid water.
b. Use copper naphthenate treatment for members in contact with the ground or not continuously protected from liquid water.

C. Install timber connectors as indicated.

1. Unless otherwise indicated, install bolts with same orientation within each connection and in similar connections.
2. Install bolts with orientation as indicated or, if not indicated, as directed by Architect.

3.3 ADJUSTING

A. Repair damaged surfaces after completing erection. Replace damaged structural glued-laminated timber if repairs are not approved by Architect.

3.4 PROTECTION

A. Do not remove wrappings on individually wrapped members until they no longer serve a useful purpose, including protection from weather, sunlight, soiling, and damage from work of other trades.

1. Coordinate wrapping removal with finishing work. Retain wrapping where it can serve as a painting shield.
2. Slit underside of wrapping to prevent accumulation of moisture inside the wrapping.

END OF SECTION

SECTION 062020 – ON-SITE SALVAGED WOOD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Salvaged lumber from mitigated trees on site, material provided by Owner.

B. Related Sections:
   1. Section 015639 "Temporary Tree & Plant Protection"
   2. Section 311000 "Site Clearing"
   3. Section 033000 "Cast-in-Place Concrete" for footings.
   4. Section 061000 "Rough Carpentry" for furring, blocking, and other carpentry work not exposed to view.
   5. Section 064013 "Exterior Architectural Woodwork"
   6. Section 064023 "Interior Architectural Woodwork"
   7. Section 099100 "Painting" for priming and backpriming of interior finish carpentry.
   8. Section 323120 "Landscape Metal Work"
   9. Section 323300 "Site Furnishings:

1.2 DEFINITIONS

A. Salvaged wood: Any wood that was not harvested for its timber value and was diverted or removed from the waste-stream

B. Reclaimed wood: Wood that is obtained from demolition or deconstruction, not harvested for its timber value, but removed because of insect, disease or circumstance.

1.3 PERFORMANCE REQUIREMENTS

A. Provide salvaged wood for use in interior and exterior architectural woodwork and millwork in accordance with Contract Drawings.

1.4 ACTION SUBMITTALS

A. Samples: Samples: Submit three samples of wood sanded and finished, minimum of 12 inches long representing range of grain, color and natural defects.

B. Shop Drawings:
   1. Refer to related sections Architectural Woodwork, Site Furnishings.

1.5 INFORMATIONAL SUBMITTALS

a. Digital photos of each piece of lumber cut by Owner for use.
b. Drawings and dimensions of each piece of lumber cut by Owner for use.
   1) Coordinate with each Sub-Contractor.
c. Drying documentation to be provided:

- Drying professional must document the trackable information for each item to be dried.
- Drying professional may combine multiple logs, pieces or bundled units for drying.
- If merged, drying professional must document every trackable information that comprises the resulting combined kiln charge or

drying stack.

- If kiln dried, drying professional will record the type of kiln, such as solar, dehumidification, RF kiln, vacuum kiln, or other.

d. Sterilization documentation to be provided:

- If declaring as "kiln dried sterilized", drying professional will record the temperature reached and duration held at that temperature.
- Method of insect sterilization. Submit which sterilization efforts were made and document the method used. If kiln dried, this will include duration at identified temperature level.

1.1 QUALITY ASSURANCE

A. Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

B. Review available Owner-furnished on-site lumber supply with Sub-Contractors prior to submitting shop drawings or performing the work.

1.2 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers between each bundle to provide air circulation.
   1. Protect materials from weather by covering with waterproof sheeting, securely anchored.
   2. Store materials out of contact with damp or wet surfaces.
   3. Stack logs flat with spacers between each log to provide air circulation.
   4. Provide for air circulation around stacks and under coverings.

1.3 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install interior finish carpentry materials until building is enclosed and weatherproof, wet-work in space is completed and nominally dry, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.
   1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.2 MATERIALS, GENERAL

A. MOBILE LUMBER MILL CONTACT INFORMATION

Lively Lumber, LLC.

661-270-6419
ryan@livelylumber.com
11820 Darling Rd
Agua Dulce, CA 91390

B. Provide salvaged wood extracted from trees on the site by Owner and meeting the following requirements.
   1. Size and Dimensions: as required by application as shown in Contract Drawings.
   2. Relative moisture content: as required by application as shown in Contract Drawings.
   3. Wood to be air dried or kiln dried to achieve relative moisture requirements.
   4. Wood must undergo proper sterilization.
   5. All foreign objects to be removed prior to milling, and post milling wherever observed

C. Allowable substitutes: acceptable when Owner-furnished on-site reclaimed lumber is not sufficient or is defective for the use.
Provide wood meeting the characteristics of the trees in section 2.2.A.

2.3 EXTERIOR WOOD ELEMENTS

A. Timber and wood elements as indicated in the drawings shall be produced using material from trees harvested on-site by Owner. If required timber quantities exceed those of acceptable material harvested on site, Contractor shall secure appropriate material from off-site sources, as approved by the Architect and Owner's Representative.
   1. All wood to be de-barked
   2. All branches/nubs removed and smoothed
   3. All edges to be eased to a 1/8" radius unless otherwise noted
   4. Install on top of well-draining material or with sleepers/stickers/spacers below for airflow and water separation
   5. Allowable substitute materials, when acceptable material is not sufficient for the Project

2.4 FABRICATION

A. Mill, plane, router, shape and sand Owner-furnished on-site lumber as required to produce elements and profiles as indicated in the Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine 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. Wood to be prepared per related specification sections ahead of delivery to site.

B. Clean wood if needed prior to installation.

3.3 INSTALLATION, GENERAL

A. Do not use materials that are unsound; warped; improperly treated or finished; inadequately seasoned; too small to fabricate with proper jointing arrangements; or with defective surfaces, sizes, or patterns.
   1. Install metal framing anchors to comply with manufacturer's written instructions.
   2. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
   3. 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 members or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
   4. Set work to required levels and lines, with members plumb, true to line, cut and fitted as shown in the Drawings.
   5. Install fasteners and/or anchors as shown in the Drawings.
   6. Securely attach exterior carpentry work to substrate by anchoring and fastening as indicated.
B. Apply finish to each installation as specified.

3.4 CLEANING

A. Clean exposed and semiexposed surfaces per wood finish product manufacturer's instructions if needed.

B. Restore damaged or soiled areas and touch up finishes if any.

3.5 PROTECTION

A. Protect installed products from damage from weather and other causes during construction.

B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.
   1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

SECTION 064013 - EXTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Exterior wood trim.
   2. Wood siding.

B. Related Sections:
   1. Section 099300 "Staining and Transparent Finishing."

1.2 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections, to ensure that exterior architectural woodwork can be supported and installed as indicated.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:
   1. Laboratory Test Reports: For composite wood products, indicating compliance with requirements for low-emitting materials.
   2. Sustainably Forestry chain of custody documentation.

C. Samples for Initial Selection: For each type of product involving selection of colors, profiles, or textures.

D. Samples for Verification:
   1. For each species and cut of lumber and panel products, with half of exposed surface finished; 50 sq. in. (300 sq. cm) for lumber and 8 by 10 inches (200 by 250 mm) for panels.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation.
   1. Protect materials from weather by covering with waterproof sheeting, securely anchored.
   2. Provide for air circulation around stacks and under coverings.

1.5 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecast weather conditions permit work to be performed and at least one coat of specified finish can be applied without exposure to rain, snow, or dampness.

B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.
   1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sustainable Design Performance Requirements:
   1. Installation Adhesives:
      a. Low-Emitting Materials: Comply with testing and product requirements of the California Department of Health Services CDPH Standard Method v1.1, using CA Section 01350, Appendix B, New Single-Family Residence Scenario.
   2. Sustainable Forestry:
      a. Wood shall be sourced from sustainably managed forests. FSC preferred, SFI acceptable when FSC products are not available.

2.2 EXTERIOR TRIM

A. Lumber Trim for Transparent Finish (Stain or Clear Finish):
   1. Species and Grade:
      a. Western red cedar; NLGA, WCLIB, or WWPA clear heart.
   2. Maximum Moisture Content: 15 percent.

B. Finger Jointing: Not allowed.

C. Face Surface: Surfaced (smooth).

D. Moldings for Transparent Finish (Stain or Clear Finish): MMPA WM 4, N-grade wood moldings, without finger jointing.

E. Species: Western red cedar.

F. Profile: As indicated on Drawings.

2.3 LUMBER WOOD SIDING

A. Provide kiln-dried lumber siding complying with DOC PS 2.

B. Species and Grade:
1. Western red cedar; NLGA, WCLIB, or WWPA clear heart.
a. Sourced from sustainably managed forests. FSC preferred, SFI acceptable when FSC products are not available.

C. Hand select wood for freedom from characteristics on exposed surfaces and edges that would impair finish appearance including decay, honeycomb, knot holes, shake, splits, torn grain, and wane.

D. Siding Members Profile: WWPA T&G siding profile 106 S2S Drop Edge + Square Edge
1. Overall Height: 7 1/8 inch.
2. Thickness: 23/32 inch.
3. Other dimensions as indicated on Drawings.

E. Modification: Preservative free, acetylation.

F. Finish: As indicated on Drawings.

2.4 FASTENERS

A. General: Provide fasteners of size and type indicated, acceptable to authorities having jurisdiction, and that comply with requirements specified in this article for material and manufacture.
1. Use stainless steel unless otherwise indicated.

B. Stainless Steel Fasteners and Bolts: ASTM F593, Alloy Group 1 or 2; with ASTM F594, Alloy Group 1 or 2 hex nuts and, where indicated, flat washers.

2.5 FABRICATION

A. Back out or kerf backs of standing and running trim wider than 5 inches (125 mm), except members with ends exposed in finished work.

B. Fabricate exterior architectural woodwork to dimensions, profiles, and details indicated.
1. Ease edges to radius indicated for the following:
2. Lumber less than 1 inch (25 mm) in nominal thickness: 1/16-inch (1.5-mm) radius.
3. Lumber 1 inch (25 mm) or more in nominal thickness: 1/8-inch (3-mm) radius.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FINISH

A. Refer to Section 099300 "Staining and Transparent Finishing."

B. Apply one coat of specified finish to siding boards and running trim prior to installation.

3.3 INSTALLATION

A. Install exterior architectural woodwork level, plumb, true in line, and without distortion.
   1. Shim as required with concealed shims.
   2. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

B. Scribe and cut exterior architectural woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

C. Anchor exterior architectural woodwork to anchors or blocking built in or directly attached to substrates.

3.4 INSTALLATION OF STANDING AND RUNNING TRIM

A. Install flat-grain lumber with bark side exposed to weather.

B. Install trim with minimum number of joints as is practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches (610 mm) long, except where necessary.
   1. Use scarf joints for end-to-end joints.
   2. Stagger end joints in adjacent and related members.

C. Fit exterior joints to exclude water.
   Cope at returns and miter at corners to produce tight-fitting joints, with full-surface contact throughout length of joint.
   1. Plane backs of casings to provide uniform thickness across joints, where necessary for alignment.

D. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.

3.5 INSTALLATION OF SIDING

A. Install siding to comply with manufacturer's written instructions.

B. Horizontal Lumber Siding:
   1. Install first course of siding, with lower edge at least 1/8 inch (3 mm) below furring strip.
      a. Nail at each furring strip.
      b. Do not allow nails to penetrate more than one thickness of siding.

2. Leave 1/8-inch (3-mm) gap at trim and corners unless otherwise recommended by manufacturer, and apply sealant.
3. Butt joints only over framing or blocking, nailing top and bottom on each side and staggering joints in subsequent courses.
4. Install prefabricated outside corners as recommended by manufacturer.

3.6 ADJUSTING

A. Replace exterior finish carpentry that is damaged or does not comply with requirements.
   1. Exterior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

B. Adjust joinery for uniform appearance.

3.7 CLEANING

A. Clean exterior finish carpentry on exposed and semiexposed surfaces.

3.8 PROTECTION

A. Protect installed products from damage from weather and other causes during construction.

B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.
   1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

SECTION 064023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Redwood furnishings fabricated from On-Site Salvaged Wood as available.
2. Interior standing and running trim.
3. Shop priming of interior architectural woodwork.

B. Related Sections:
1. Section 055000 “Metal Fabrications” for reception desk and integrated steel for casework.
2. Section 062020 “On-Site Salvaged Wood” for owner-furnished wood salvaged on site.
3. Section 079200 “Joint Sealants” for sealants appropriate to substrates.
4. Section 081416 "Flush Wood Doors" for wood door frames.

1.2 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections, to ensure that interior architectural woodwork can be supported and installed as indicated.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

A. Sustainable Design Submittals:
1. Laboratory Test Reports: For composite wood products, indicating compliance with requirements for low-emitting materials.
2. Sustainably Forestry chain of custody documentation.

B. Shop Drawings:
1. Include the following:
a. Dimensioned plans, elevations, and sections.
b. Attachment details.
2. Show large-scale details.
3. Show locations and sizes of furring, blocking, and hanging strips, including blocking and reinforcement concealed by construction and specified in other Sections.

C. Samples: For each exposed product and for each shop-applied color and finish specified.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

B. Installer Qualifications: Manufacturer of products.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with the Architectural Woodwork Standards, Section 2.

B. Do not deliver interior architectural woodwork until painting and similar finish operations that might damage woodwork have been completed in installation areas.

C. Store woodwork in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.
   1. Handle and store fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install interior architectural woodwork until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of the construction period.

B. Established Dimensions: Where interior architectural 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. Sustainable Design Performance Requirements:
   1. Installation Adhesives:
      a. Low-Emitting Materials: Comply with testing and product requirements of the California Department of Health Services CDPH Standard Method v1.1, using CA Section 01350, Appendix B, New Single-Family Residence Scenario.
   2. Sustainable Forestry:
      a. Wood shall be sourced from sustainably managed forests. FSC preferred, SFI acceptable when FSC products are not available.

2.2 ARCHITECTURAL WOODWORK, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

2.3 INTERIOR STANDING AND RUNNING TRIM FOR OPAQUE FINISH

A. Architectural Woodwork Standards Grade: Custom.
1. Wood Species: As indicated on Drawings.

2.4 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Nailers: 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.
1. Provide metal expansion sleeves or expansion bolts for post-installed anchors.
2. 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.

D. Sealant: For application between base of running trim and hard or resilient flooring.

2.5 FABRICATION

A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

B. Fabricate interior architectural woodwork to dimensions, profiles, and details indicated.
1. Ease edges to radius indicated for the following:
a. Edges of Solid-Wood (Lumber) Members: 1/16 inch unless otherwise indicated.
b. Edges of Rails and Similar Members More Than 3/4 Inch Thick: 1/8 inch.

C. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site.
1. Disassemble components only as necessary for shipment and installation.
2. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting.

2.6 SHOP PRIMING

A. Preparations for Finishing: Comply with the Architectural Woodwork Standards for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar

preparations for finishing interior architectural woodwork, as applicable to each unit of work.

B. Interior Architectural Woodwork for Opaque Finish: Shop prime with one coat of wood primer as specified in Section 099100 "Painting."
   1. Backpriming: Apply one coat of primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to surfaces installed in contact with concrete or masonry and to end-grain surfaces.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition interior architectural woodwork to humidity conditions in installation areas for not less than 72 hours prior to beginning of installation.

B. Before installing interior architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming of concealed surfaces.

3.2 INSTALLATION

A. Grade: Install interior architectural woodwork to comply with same grade as item to be installed.

B. Assemble interior architectural woodwork and complete fabrication at Project site to the extent that it was not completed during shop fabrication.

C. Install interior architectural woodwork level, plumb, true in line, and without distortion.
   1. Shim as required with concealed shims.
   2. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

D. Scribe and cut interior architectural woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor interior architectural woodwork to anchors or blocking built in or directly attached to substrates.
   1. Secure with countersunk, concealed fasteners and blind nailing.
   2. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with interior architectural woodwork.

F. Standing and Running Trim:
   1. Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible.
   2. Do not use pieces less than 96 inches long, except where shorter single-length pieces are necessary.
   3. Scarf running joints and stagger in adjacent and related members.
   4. Fill gaps, if any, between top of base and wall with latex sealant, painted to match wall.

5. Fill gaps, if any, between bottom of base and hard flooring with sealant. Refer to Section 079200 "Joint Sealants."
6. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches.

END OF SECTION

SECTION 064116 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-clad architectural cabinets.
   a. Stainless steel lining at dishwasher rack storage.
2. Cabinet hardware and accessories.
3. Miscellaneous materials.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets that are concealed within other construction before cabinet installation.
2. Section 123661.19 “Quartz Agglomerate Countertops” for countertops installed on casework.

1.2 DEFINITIONS

A. Concealed Surfaces of Casework: Surfaces not usually visible after installation, including sleepers, web frames, dust panels, bottoms of drawers, and ends of casework installed directly against and completely concealed by walls or other casework, and tops of wall cabinets and utility cabinets.

B. Exposed Surfaces of Casework: Surfaces visible when doors and drawers are closed, including visible surfaces in open cabinets or behind glass doors.

C. Semiexposed Surfaces of Casework: Surfaces behind opaque doors or drawer fronts, including interior faces of doors, interiors and sides of drawers, and bottoms of wall cabinets.

1.3 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded cabinets.

B. Hardware Coordination: Provide keying of cabinets per Owner requirements.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data:

1. Plastic-laminate-clad architectural cabinets.
2. Cabinet hardware and accessories.
3. Miscellaneous materials.

B. Product Data Submittals: For each product.

C. Sustainable Design Submittals:
1. Laboratory Test Reports: For composite wood products, indicating compliance with requirements for low-emitting materials.
2. Sustainably Forestry chain of custody documentation.

D. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Show large-scale or full-size 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 and holes for items installed in plastic-laminate architectural cabinets.
5. Apply WI Certified Compliance Program label to Shop Drawings.
6. Indicate lock placement and keying schedule.

E. Samples: For each exposed product and for each color and texture specified, in manufacturer's or manufacturer's standard size.

F. Samples for Initial Selection: For each type of exposed finish.

G. Samples for Verification: For the following:

1. Plastic Laminates: 8 by 10 inches (200 by 250 mm), for each type, color, pattern, and surface finish required.

2. Exposed Cabinet Hardware and Accessories: One full-size unit for each type and finish.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and Installer.

B. Product Certificates: For each type of product.

1.7 CLOSEOUT SUBMITTALS

A. Quality Standard Compliance Certificates: WI Certified Compliance Program certificates.

1.8 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

1. Manufacturer's Certification: Licensed participant in WI's Certified Compliance Program.

B. Installer Qualifications: Manufacturer of products or licensed participant in WI's Certified Compliance Program.

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 mockups of typical architectural cabinets as shown on Drawings.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have been completed in installation areas. Store cabinets in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.10 FIELD CONDITIONS

A. Environmental Limitations without Humidity Control: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.

B. Environmental Limitations with Humidity Control: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between [25 and 55] [43 and 70] [20 and 50] <Insert numbers> percent during the remainder of the construction period.

C. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed/concealed by construction, and indicate measurements on Shop Drawings.

D. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming

at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 Product Requirements:

A. Sustainable Design Performance Requirements:
1. Low-Emitting Materials: Composite wood products shall made using ultra-low-emitting formaldehyde resins as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde.
2. Sustainable Forestry: Wood cores shall be made from wood sourced from sustainably managed forests. FSC preferred, SFI acceptable when FSC products are not available.

2.2 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of cabinets indicated for construction, finishes, installation, and other requirements.

1. Provide labels and certificates from WI certification program indicating that woodwork and installation complies with requirements of grades specified.

B. Architectural Woodwork Standards Grade: Premium.

C. Type of Construction: Frameless Face frame.

D. Door and Drawer-Front Style: Reveal overlay.

1. Reveal Dimension: As indicated.

E. High-Pressure Decorative Laminate: ISO 4586-3, grades as indicated.

F. Exposed Surfaces:

1. Plastic-Laminate Grade: HGS.
2. Edges: Grade HGS minimum thickness, matching laminate in color, pattern, and finish.
3. Pattern Direction: As indicated.

G. Semiexposed Surfaces:

1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, ISO 4586-3.

a. Edges of Plastic-Laminate Shelves: PVC tape, 0.018-inch (0.460-mm) 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, ISO 4586-3, grade to match exposed surface.

2. Drawer Sides and Backs: Solid-hardwood lumber.
3. Drawer Bottoms: Hardwood plywood.

H. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, ISO 4583-3, grade to match exposed surface.

I. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners.

J. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
1. Match Architect's sample.

2.3 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. Wood Moisture Content: 5 to 10 percent.

B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated. Provide wood from sustainably managed forests, FSC or similar.
1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130 Insert grade.
2. Particleboard (Medium Density): ANSI A208.1, Grade M-2 Grade M-2-Exterior Glue.
3. Softwood Plywood: DOC PS 1, medium-density overlay.

2.4 SHEET METAL MATERIALS

A. Provide stainless steel sheet lining at kitchen casework recess for dishwasher rack storage.
1. Finish: Brushed.
2. Gauge: 18.

2.5 CABINET HARDWARE AND ACCESSORIES

A. Cabinet Hardware: Provide cabinet hardware and accessory materials associated with architectural cabinets.

B. Frameless Concealed Hinges (European Type): ANSI/BHMA A156.9, B01602, 100 degrees of opening.

C. Back-Mounted Pulls: ANSI/BHMA A156.9, B02011.

D. Wire Pulls: Back mounted, solid metal, 4 inches (100 mm) long, 5/16 inch (8 mm) in diameter.

E. Catches: Ball friction catches, ANSI/BHMA A156.9, B03013.

F. Adjustable Shelf Standards and Supports: ANSI/BHMA A156.9, B04071; with shelf rests, B04081.

G. Shelf Rests: ANSI/BHMA A156.9, B04013; metal.

H. Drawer Slides: ANSI/BHMA A156.9.

1. Standard Duty (Grade 1 and Grade 2): Side mount and extending under bottom edge of drawer.
2. Heavy-Duty (Grade 1HD-100 and Grade 1HD-200): Side mount.

a. Type: Full extension.
b. Material: Galvanized steel ball bearing slides.
c. Motion Feature: Soft close dampener.

3. General-purpose drawers more than 3 inches (75 mm) high, but not more than 6 inches (150 mm) high and not more than 24 inches (600 mm) wide, provide 75 lb (34 kg) load capacity.

I. Door Locks: ANSI/BHMA A156.11, E07121.
1. Provide for all kitchen cabinet doors.

J. Drawer Locks: ANSI/BHMA A156.11, E07041.
1. Provide for all kitchen cabinet doors.

K. Door and Drawer Silencers: ANSI/BHMA A156.16, L03011.

L. Grommets for Cable Passage: [1-1/4-inch (32-mm)] [2-inch (51-mm)] <Insert dimension> OD, molded-plastic grommets and matching plastic caps with slot for wire passage.

1. Color: As selected by Architect.

M. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for ANSI/BHMA finish number indicated.
1. Satin Stainless Steel: ANSI/BHMA 630.

N. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in ANSI/BHMA A156.9.

2.6 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.

1. Adhesive for Bonding Edges: Hot-melt adhesive.

2.7 FABRICATION

A. Fabricate architectural cabinets to dimensions, profiles, and details indicated.

B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
1. Trial fit assemblies at manufacturer's shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

3.2 INSTALLATION

A. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.

B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.

C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.

D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm) 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. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches (400 mm) o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch (38-mm) penetration into wood framing, blocking, or hanging strips] [No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish] [toggle bolts through metal backing or metal framing behind wall finish].

3.3 FIELD QUALITY CONTROL

A. Inspections: Provide inspection of installed Work through WI's Certified Compliance Program certifying that woodwork, including installation, complies with requirements of the Architectural Woodwork Standards for the specified grade.

1. Inspection entity is to prepare and submit report of inspection.

3.4 ADJUSTING AND CLEANING

A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects. Where not possible to repair, replace architectural cabinets. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean cabinets on exposed and semiexposed surfaces.

END OF SECTION 064116

SECTION 066400 - PLASTIC PANELING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Plastic sheet paneling.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:
1. Laboratory Test Reports: For adhesives and sealants, indicating compliance with requirements for low-emitting materials.

C. Samples: For plastic paneling and trim accessories.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sustainable Design Performance Requirements:
1. Adhesives and sealants shall comply with the following:
a. Low-Emitting Materials: Testing and product requirements of the California Department of Health Services CDPH Standard Method v1.1, using CA Section 01350, Appendix B, New Single-Family Residence Scenario.

2.2 PLASTIC SHEET PANELING

A. Glass-Fiber-Reinforced Plastic Paneling: Gelcoat-finished, glass-fiber-reinforced plastic panels complying with ASTM D5319.
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
a. Crane Composites, Inc.
b. Glasteel.
c. Newcourt, Inc.
d. Nudo Products, Inc.
e. Parkland Plastics, Inc.
2. Surface-Burning Characteristics: As follows when tested by a qualified testing agency according to ASTM E84. Identify products with appropriate markings of applicable testing agency.
a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 450 or less.

3. Nominal Thickness: Not less than 0.075 inch.

2.3 ACCESSORIES

A. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, and caps as needed to conceal edges.
   1. Color: Match panels.

B. Adhesive: As recommended by plastic paneling manufacturer.

C. Sealant: Mildew-resistant, single-component, neutral-curing or acid-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.

B. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.

C. Lay out paneling before installing. Locate panel joints to provide equal panels at ends of walls not less than half the width of full panels.

3.2 INSTALLATION

A. Install plastic paneling according to manufacturer's written instructions.

B. Install panels in a full spread of adhesive.

C. Install trim accessories with adhesive and nails or staples. Do not fasten through panels.

D. Fill grooves in trim accessories with sealant before installing panels, and bed inside corner trim in a bead of sealant.

E. Maintain uniform space between panels and wall fixtures. Fill space with sealant.

F. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION

SECTION 070553 - FIRE AND SMOKE ASSEMBLY IDENTIFICATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Wall-identification for fire and smoke assemblies.

B. Related Sections:
1. Section 078413 "Penetration Firestopping" for penetration firestopping identification requirements.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:
1. Show proposed locations of identification and indicate color.
2. Show text, typestyles, and layout.

1.3 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 WALL IDENTIFICATION

A. Wall Identification: Preprinted self-adhesive labels or decals, signs, or stenciled-on paint as follows:
1. Font: Minimum 3 inches high characters in a contrasting color, with minimum 0.375-inch wide strokes.
2. Text: "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS."

2.2 PAINT MATERIALS

A. Provide paint materials in accordance with Division 09 Section "Painting."

PART 3 - EXECUTION

3.1 GENERAL

A. Before installation, verify that surfaces are clean and free of materials or debris that would impair installation.

B. Apply paint in accordance with requirements specified in Division 09 Section "Painting."

C. Apply labels, signs, or field-applied stenciling in accessible, concealed locations.

3.2 MARKING FIRE AND SMOKE ASSEMBLIES

A. Wall-Identification Signs: Permanently identify both sides of each fire wall, fire barrier, fire partition, smoke barrier, and smoke partition. Place identification in accessible, concealed floor, floor-ceiling, or attic space within 15 feetfrom each end of wall or partition and at intervals not exceeding 30 feet, measured horizontally along the assembly.

END OF SECTION

SECTION 071326 - SELF-ADHERING SHEET FLASHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Self-adhered Sheet Flashing.

B. Related Work:
1. Section 061656 "Air-Barrier Water-Resistant Sheathing System".
2. Section 076200 "Sheet Metal Flashing and Trim".

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by flashing manufacturer.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement flashing material for work that does not comply with requirements or that fails to remain watertight within specified warranty period.
1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SELF-ADHERING SHEET FLASHING

A. Provide self-adhering sheet flashing as indicated: Minimum 30-mil (1.5-mm) nominal thickness, self-adhering sheet consisting of 24-mil (1.5-mm) synthetic composite sheet laminated on one side to a 8-mil- (0.10-mm-) thick, polyethylene-film reinforcement, and with release liner on adhesive side; formulated for application with primer or surface conditioner that complies with VOC limits of authorities having jurisdiction.
1. Products: Subject to compliance with requirements.
2. Physical Properties:
   a. Tensile Strength, Membrane: 1000 psi (1.7 MPa) minimum; ASTM D412, Die C, modified.
   b. Ultimate Elongation: 150 percent minimum; ASTM D412, Die C, modified.
   c. Low-Temperature Flexibility: Pass at minus 20 deg F (minus 29 deg C); ASTM D1970/D1970M.
   d. Crack Cycling: Unaffected after 100 cycles of 1/8-inch (3-mm) movement; ASTM C836/C836M.
   e. Puncture Resistance: 100 lbf (180 N) minimum; ASTM E154/E154M.
   f. Water Absorption: 0.1 percent weight-gain maximum after 48-hour immersion at 70 deg F (21 deg C); ASTM D570.
   g. Water Vapor Permeance: 0.1 perm (2.9 ng/Pa x s x sq. m) maximum; ASTM E96/E96M, Water Method.
   h. Hydrostatic-Head Resistance: 200 feet minimum; ASTM D5385.

B. Mastic, Adhesives, and Detail Tape: Liquid mastic and adhesives, and adhesive tapes recommended by manufacturer.

2.2 AUXILIARY MATERIALS

A. Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.
1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.

B. Primer: Liquid primer recommended for substrate by sheet-waterproofing material manufacturer.

C. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by sheet-waterproofing material manufacturer.

D. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, of trowel grade or low viscosity.

E. Substrate Patching Membrane: Low-viscosity, two-component, modified asphalt coating.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for flashing application.

B. Mask off adjoining surfaces not receiving flashing to prevent spillage and overspray affecting other construction.

3.2 INSTALLATION OF SELF-ADHERED SHEET FLASHING

A. Install sheets according to flashing manufacturer's written instructions.

B. Apply primer to substrates at required rate and allow it to dry as required by manufacturer. 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 flashing. Accurately align sheets and maintain uniform 2-1/2-inch- minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure watertight installation.
1. When ambient and substrate temperatures range between 25 and 40 deg F, install sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F.

D. Apply continuous sheets over already-installed sheet strips, bridging substrate cracks, construction, and contraction joints as required by manufacturer.

E. Seal edges of sheet-waterproofing terminations with mastic as required by manufacturer.

F. Install sheet-flashing and auxiliary materials to tie into adjacent waterproofing.

G. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet flashing extending 6 inches beyond repaired areas in all directions.

H. Immediately install protection course with butted joints over waterproofing membrane.
1. Drainage panels may be used in place of a separate protection course to vertical applications when approved by waterproofing manufacturer and installed immediately.

3.3 PROTECTION, REPAIR, AND CLEANING

A. Do not permit foot traffic on unprotected membrane.

B. Correct deficiencies in or remove flashing that does not comply with requirements; repair substrates, reapply flashing, 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

SECTION 071416 - COLD FLUID-APPLIED WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Polyurethane waterproofing.

B. Related Sections:
1. Section 061656 "Air-Barrier Water-Resistant Sheathing System" for vapor-permeable liquid applied flashing at exterior wall sheathing.
2. Section 071326 "Self-Adhering Sheet Flashing" for vapor-closed self-adhered sheet flashing where indicated.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:
1. Show locations and extent of waterproofing.
2. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

PART 2 - PRODUCTS

2.1 POLYURETHANE WATERPROOFING

A. Two-Component, Unmodified Polyurethane Waterproofing: ASTM C836/C836M.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Carlisle Coatings & Waterproofing Inc; CCW 703 Liquiseal.
b. C.I.M Industries (Chase Corp.); CIM 1000.
c. Gaco Western LLC; GacoFlex LM-60.
d. Urethane Polymers International, Inc.; UIM-6430.

2.2 AUXILIARY MATERIALS

A. Primer: Manufacturer's standard primer, sealer, or surface conditioner; factory-formulated.

B. Sheet Flashing: 50-mil- minimum, nonstaining, uncured sheet neoprene.
   1. Adhesive: Manufacturer's recommended contact adhesive.

C. Joint Sealant: Multicomponent polyurethane sealant, compatible with waterproofing; and as recommended by manufacturer for substrate and joint conditions.
   1. Backer Rod: Closed-cell polyethylene foam.

PART 3 - EXECUTION

3.1 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, acid residues, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, and other projections, and fill honeycomb, aggregate pockets, holes, and other voids.

E. Prepare surfaces at terminations and penetrations through waterproofing and at expansion joints, drains, sleeves, and corners according to waterproofing manufacturer's written instructions and to recommendations in ASTM C1471/C1471M.

F. Prepare, treat, rout, and fill joints and cracks in substrate according to waterproofing manufacturer's written instructions and to recommendations in ASTM C1471/C1471M. Before coating surfaces, remove dust and dirt from joints and cracks according to ASTM D4258.

3.2 INSTALLATION OF WATERPROOFING

A. Apply waterproofing according to manufacturer's written instructions and to recommendations in ASTM C1471/C1471M.

B. Unreinforced Waterproofing Applications.
   1. Apply one or more coats of waterproofing to obtain a seamless membrane free of entrapped gases and pinholes, with a minimum dry film thickness of 60 mils .

3.3 PROTECTION

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.

END OF SECTION

SECTION 071700 - BENTONITE WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bentonite waterproofing at below-grade concrete walls, site retaining walls and elevator pit.
2. Molded-sheet drainage panels.
3. Preformed waterstops at all penetrations and cold joints in concrete.

B. Related Requirements:

1. Division 03 "Concrete" Sections for coordination with formwork, waterstops, and concrete placement.
2. Division 31 "Earthwork" Sections for excavating and backfilling.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Conference: Conduct conference at Project Site.

1. Review requirements for waterproofing products and installation, including surface preparation, substrate conditions, project and manufacturer's details, installation procedures, mockups, testing and inspection requirements, protection and repairs, and coordination and sequencing of waterproofing installation with work of other Sections.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include product specifications and manufacturer's written installation instructions.

B. Shop Drawings:

1. Indicate metal or membrane flashings; expansion and control joints; sealing at openings, projections, reglets, slots and sleeves.
2. Indicate coordination of interface between different systems and continuity of waterproofing at transitions, penetrations and terminations. Include Project specific details for every type of joint, flashings, penetrations, corners, and terminations.
3. Submit standard and custom details for conditions encountered on this Project.
4. Manufacturer is required to sign shop drawings stating that submittal details meet manufacturer's Guarantee requirements for this specific Project.
5. Show conditions at exaction retention system.

C. Material Certificates: For each type of bentonite waterproofing, from manufacturer.

D. Compatibility Letter and Chart:

1. Furnish a compatibility letter certifying physical and chemical compatibility of products in this section with all other waterproofing, weather barrier, roofing, self-

adhered flashing and sealant products in the Project. Coordinate with the following Sections:

a. Section 076200 "Sheet Metal Flashing and Trim".

b. Section 079200 "Joint Sealants".

2. Furnish input from this section toward a single Compatibility Chart to be compiled by the CM/ Contractor. Compatibility Chart shall indicate the following:

a. All waterproofing, weather barrier, roofing, self-adhered flashing, fluid-applied flashing and sealant products.

b. Which other products from this group they interface (are in contact with) in the Project.

c. The physical and chemical compatibility between those interfaced products.

E. Soil Tests: As required by manufacturer, furnish and install substrate soil testing to meet the manufacturer's criteria.

F. Qualification Data: For Installer and manufacturer.

G. Manufacturer Certificates: Signed by roofing manufacturer certifying that waterproofing system complies with requirements specified in "Performance Requirements" Article.

1. Submit evidence of compliance with performance requirements.

H. Product Test Reports: For components of waterproofing system, tests performed by manufacturer and witnessed by a qualified testing agency.

I. Research/ Evaluation Reports: For components of waterproofing system, from ICC-ES.

J. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain bentonite waterproofing system from single source from single manufacturer. Obtain accessory products used with bentonite waterproofing from sources acceptable to bentonite waterproofing manufacturer.

B. Installer Qualifications: At least 5 years documented experience in work of the type required by this Section, which can comply with manufacturer's warranty requirements, and is an Approved Applicator as determined by the waterproofing system manufacturer.

1. Alternatively, Bidders may be considered appropriate for the Project by providing examples and references for three projects of similar scale and type to this Project, for review and approval by the Owner's Representative.

C. Manufacturer Qualifications: Waterproofing and all accessory products shall be furnish and install by a single manufacturer with a minimum of 25 years documented experience in the direct production and sales of waterproofing systems.

1. Manufacturer shall furnish field service representation during construction, approval process for an acceptable installer, recommendations for appropriate installation methods, and conducting a final inspection of the waterproofing system applied.

D. Observation and Inspection: Manufacturer's representative shall attend meetings, installations and inspections at Project site as required to satisfy warranty requirements.

E. Integrated (In-Place) Mockups: Install or build mockups to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Install the first 100 square feet of membrane as a field mock-up of installation methods to be reviewed by Owner's Representative and waterproofing consultant. Include examples of surface preparation, waterproofing application and flashing, transition, and termination conditions

2. Build mockup using typical components, attachments to building structure, and methods of installation.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Owner's Representative in writing.

4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in manufacturer's original unopened and undamaged containers.

B. Store materials in a dry, well-ventilated space.

C. Remove and replace bentonite materials that have been prematurely exposed to moisture.

1.6 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit bentonite waterproofing to be installed according to manufacturers' written instructions and warranty requirements.

1. Do not apply waterproofing materials to surfaces where ice or frost is visible. Do not apply bentonite waterproofing materials in areas with standing water.

2. Placing bentonite clay products in panel or composite form on damp surfaces is allowed if approved in writing by manufacturer.

1.7 PRE-INSTALLATION CONFERENCE

A. Conduct pre-installation conference in accordance with Section 013119. Conduct pre-installation conference prior to waterproofing membrane installation. Meeting attendees shall include representatives from the Contractor, waterproofing installer, waterproofing material manufacturer, sheet metal installer, waterproofing consultant and Owner.

B. Agenda:

1. Review requirements for Work and conditions which could possibly interfere with successful performance of Work.

2. Review Project Specifications and Drawings.

3. Establish installation schedules and sequence.

4. Coordinate work with in-place and subsequent construction.
5. Review weather and working conditions.
6. Review guarantee conditions and verify manufacturer's acceptance of conditions.
7. Review installation procedures, including:
    a. Substrate requirements.
    b. Waterproofing installation.
    c. Phasing and sequencing requirements.
    d. Termination, flashing, and penetration requirements.
    e. Review inspection, testing, and quality control procedures.
    f. Establish timing of manufacturer's field inspections.
    g. Review protection requirements for construction period beyond waterproofing installation.

C. Conduct tour of areas to be waterproofed and report on possible problem areas and recommended remedies.

1.8 GUARANTEE

A. Furnish to Owner a written guarantee for systems and system components specified in this Section against all defects in materials and workmanship, agreeing to repair or replace those systems and system components that do not comply with requirements or that fail to perform as required, and to maintain performance indicated or required for 10 years from date of acceptance.

PART 2 - PRODUCTS

2.1 BENTONITE MEMBRANE WATERPROOFING SYSTEM

A. Composite Bentonite Membrane: Pre-applied waterproofing membrane comprised two high strength interlocking geotextiles encapsulating granular sodium bentonite, pressure sensitive adhesive, and weather resistant protective coating; formulated for below-grade concrete foundations.

1. Basis-of-Design Product: Subject to compliance with requirements, provide
    a. CETCO Voltex Waterproofing Membrane
    b. or comparable product by one of the following:
        1) W.R. Meadows.
        2) Or approved equal.
2. Granular Sodium Bentonite Content: 1.0 lbs./sq.ft. minimum between two layers of geotextile fabric, heat-fused together.
3. Shall be capable of mechanical bond between geotextiles and concrete.
    a. Peel Adhesion to Concrete: Average adhesion value of 15 lbs./linear in. minimum per ASTM D903.
    b. Bond shall prevent water migration between waterproofing and concrete.

B. Installation at Horizontal-to-Vertical Junctures: Furnish loose bentonite granules or equal.

1. Granular Bentonite: Sodium bentonite clay containing a minimum of 90 percent montmorillonite (hydrated aluminum silicate), with a minimum of 90 percent passing a No. 20 sieve.

C. Detailing at Vertical Junctures and Penetrations: Furnish non-hydrated expandable mastic of trowelable consistency.

1. Bentonite Mastic: Trowelable consistency, bentonite compound, specifically formulated for application at joints and penetrations.

D. Seam Tapes:

1. Standard Seam Tape: Permanent seam tape 4 inches wide composed of 60 mils thick rubberized asphalt membrane laminated to a polyethylene reinforcing film; for protection of seams against debris intrusion and for temporary terminations during periods of exposure to rain. Tape all seams throughout application.

2. Seam Tape at Contours and Overlaps: Non-reinforced, adhesive tape of partially cross-linked polymeric elastomers 2 inches wide by 1/8-inch thick for molding form-fit seals around difficult contours and for taping seams within overlaps.

3. Seam Tape at Embedments and Overlaps: Pressure sensitive, double-sided tape laminate of bentonite sandwiched between a netting and non-woven fabric for wrapping through-concrete imbeds and other detailing.

E. Primer: Adhesive bonding agent primer formulated for use with tapes and pressure-sensitive waterproofing accessories.

F. Sealant: One-part, gunnable-grade, polyurethane sealant for termination seals and other sealing recommended by manufacturer.

G. Furnish and install materials using installation techniques required by manufacturer for blindside waterproofing.

H. Application: Below-grade concrete walls, site retaining walls and elevator pit.

2.2 MOLDED-SHEET BASE DRAINAGE PANEL

A. Nonwoven-Geotextile-Faced, Molded-Sheet Base Drainage Panel: Waterproofing manufacturer's recommended composite subsurface drainage panel consisting of a three dimensional, 1/4-inch-thick polystyrene core covered by a nonwoven, polypropylene facing. Provide transition pieces and side-outlet assemblies.

B. Foundation Wall Drainage: Waterproofing manufacturer's recommended two-layer drainage mat with polystyrene core covered by a nonwoven, polypropylene facing. Provide transition pieces and side-outlet assemblies.

2.3 INSTALLATION ACCESSORIES

A. Preformed Waterstop: Waterproofing manufacturer's recommended composite waterstop containing expandable, granular bentonite, for use at cold joints at footings, grade beams, floor slabs and wall areas; supplied by the waterproofing membrane manufacturer; designed specifically for vertical and horizontal joints in concrete construction.

1. Coordinate waterstop requirements with Section 033000 "Cast-in-Place Concrete" for provision and properly sequenced installation. Waterstops shall be furnished and installed at the following locations:
    a. Subgrade cold joints.
    b. All other below-grade conditions recommended by the waterproofing manufacturer.
    c. Above-grade, exterior-exposed concrete joints.
    d. Concrete planters and water retention enclosure cold joints.
    e. All other above-grade conditions recommended by the waterproofing manufacturer.

B. Termination Bar: Extruded aluminum or formed stainless steel bars with upper flange to receive sealant terminations.

C. Sheet Metal Counter Flashing: 24-gauge stainless steel sheet metal, with minimum 1/4 inch wide hem at bottom edge. Counterflashing to be fabricated with sufficient width to extend 4 inches minimum below grade As indicated in Section 076200 "Sheet Metal Flashing and Trim".
    1. Application: Top edge termination of the waterproofing assembly.

D. Tieback Cover: As approved by the membrane manufacturer.

E. Fasteners:
    1. For Attachment of Drainage Composite at Blind Side Applications: Corrosion-resistant fasteners, approved by the waterproofing membrane manufacturer, length sufficient to penetrate underlying components by 1 inch minimum.
        a. Steel Staples: May be used as approved and recommended by membrane manufacturer for use according to Project conditions.
    2. For Termination Bar: Corrosion-resistant fasteners approved by the waterproofing membrane manufacturer, length sufficient to penetrate underlying components by 1 inch minimum.
    3. For Other Attachments: As appropriate for substrate materials, as recommended by the membrane manufacturer.

F. Penetration Seal: Modular mechanical seal of interlocking rubber links.
    1. Link-Seal Modular Seals by Garlock, div. of Enpro Industries, Inc.; www.garlock.com, or equal.

G. Grout: Non-ferrous, non-shrink grout; meeting requirement s of ASTM C827.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate preparations affecting performance of bentonite waterproofing.

B. Verify that substrate is complete and that work that will penetrate waterproofing is complete and rigidly installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

D. Installation of waterproofing constitutes acceptance of substrate conditions by installer.

3.2 PREPARATION

A. Clean, prepare, and treat substrates. Fill voids with cement grout or as recommended by manufacturer.

1. Ensure clean, dust-free, and dry substrate prior to waterproofing application.

B. Mask-off adjoining surfaces not indicated to receive waterproofing to prevent spillage affecting other construction.

C. Where work of this Section will be installed on earth retaining system, fill gaps and voids in earth retaining system to conform with waterproofing manufacturer's requirements; fill voids and cavities exterior of wood-lagged shoring with sand or cement slurry; remove nails in wood lagging.

D. Coordinate work in the vicinity of waterproofing to ensure proper conditions for installing the waterproofing system and to prevent damage to waterproofing after installation.

E. Formed Concrete Surfaces: Remove fins and projections. Fill voids, rock pockets, form-tie holes, and other defects with bentonite mastic or cement grout patching material according to manufacturer's written instructions.

F. Horizontal Concrete Surfaces: Remove debris, standing water, oily substances, mud, and similar substances that could impair the bonding ability of concrete or the effectiveness of waterproofing. Fill voids, cracks greater than 1/8 inch, honeycomb areas, and other defects with bentonite mastic or cement grout patching material according to manufacturer's written instructions.

G. Excavation Support and Protection System: If water is seeping, use plastic protection sheets or other suitable means to prevent wetting the bentonite waterproofing. Fill minor gaps and spaces 1/8 inch wide or wider with wood, metal, concrete, or other appropriate filling material. Cover or fill large voids and crevices with cement mortar according to manufacturer's written instructions.

H. Furnish and install plastic protection sheet at all locations where water seepage occurs. Plastic protection sheet shall be applied directly against blind-side substrate and sidewalk prior to installation of the waterproofing system.

3.3 INSTALLATION, GENERAL

A. Install waterproofing and accessories according to manufacturer's written instructions.

1. Do not install unprotected products to damp, frozen, dirty, or dusty surfaces.

2. Coordinate with installation of perimeter drains and subdrainage mat system.

3. Apply granular bentonite around penetrations in horizontal surfaces and changes in plane according to manufacturer's details in preparation for granular bentonite tubes and mastic.

4. Apply granular bentonite tubes, bentonite mastic, or both at changes of plane, construction joints in substrate, projections, and penetrations.

B. Protect waterproofing from damage and wetting before and during subsequent construction operations. Repair punctures, tears, and cuts according to manufacturer's written instructions.

C. Install Preformed Waterstop at penetrations in slabs, walls and at elevator pit. Apply at cold seam between concrete deck pours.

3.4 INSTALLATION OF BENTONITE MEMBRANE WATERPROOFING SYSTEM

A. General: Install a continuous layer of waterproofing membrane with ends and edges lapped a minimum of 3 inches. Stagger end joints between membranes. Seal joints with permanent seam tape.

B. Below Elevator Pit Slab: Apply waterproofing membrane with HDPE side down and staple ends and edges.

1. Install at applications indicated; continue waterproofing through key joints between footings or slabs and foundation walls, and extend a minimum of 8 inches up or beyond perimeter slab forms.

2. Protect waterproofing from damage caused by reinforcing bar supports with sharp edges.

C. Vertical Concrete: Apply mastic around penetrations and form continuous 2- inch cant at intersection of footings and walls with mastic.

1. Starting at lowest point, install a layer of waterproofing membrane horizontally, extending a minimum of 6 inches onto the footing. Lap membrane ends and edges a minimum of 2 inches.

2. Secure membrane to wall with adhesive or washer-headed fasteners, and tape terminations of membrane at grade.

D. Excavation Support and Protection: Cut, clean, and treat tiebacks and similar projections. Encase tieback rods, nuts, and plates. If water is present, cover shoring and lagging with plastic protection sheets.

1. Starting at lowest point, install a layer of waterproofing membrane, with ends and edges lapped and nailed to shoring.

E. Seams and Laps: Apply Manufacturer's seam tape at all seams and laps and secure as required by Manufacturer. Apply primer for adhesion of seam tape

3.5 INSTALLATION OF MOLDED-SHEET DRAINAGE PANELS

A. Blind-Side Application:

1. Where continuous moisture is evident through substrate, cover surface with polyethylene sheet; lap joints 4 inches minimum.

2. Subdrainage Mat System:

a. Install subdrainage mat system over retention system prior to waterproof installation.

b. Install drainage mat in accordance with manufacturer's instructions, lapping filter fabric 3 inches at edges. Fold a 4 to 6 inch wide filter fabric flap behind drainage composite core at top edge of termination.

c. Install drainage mat over excavation retention system with filter fabric side facing retention system.

d. Install foundation wall drainage system over excavation retention system at bottom edge of subgrade drainage mat, in accordance with

manufacturer's installation requirements. Provide manufacturer supplied end splice and corner accessories. Provide manufacturer supplied side outlet and end outlet drain fittings at drain locations.

e. Prior to application of waterproofing or placement of concrete, inspect drainage mat for defects, voids or displacement. Repair or replace as necessary to provide complete coverage.

3. Ensure that vertical surfaces to receive waterproofing system conform to manufacturer's requirements as applicable to the earth retaining system employed prior to commencing installation; contact manufacturer for requirements of project conditions not provided for in installation manuals.

4. Install waterproofing membrane starter-strip to vertical surfaces of earth retaining system with bentonite-side facing applicator prior to placement of concrete footings or foundation mat slab.

5. Prepare all vertical inside corners that occur along the earth retaining system by fastening a minimum 12" wide strip of membrane pressed tight into corner with bentonite-side facing applicator; securely fasten along vertical edges 3" on center.

6. Install membrane sheets oriented vertically with bentonite-side facing applicator; overlap membrane sheets 4" minimum; securely fasten membrane through both sheets at overlap areas with staples every 3" on center.

7. Verify which penetrations must be accessed after concrete placement for completion of waterproofing detail treatment and ensure that sufficient access to membrane is provided within a formed box-out; verify which penetrations will not be accessed after concrete placement for completion of waterproofing detail treatment and ensure that final detailing procedures are completed prior to shotcreting. Waterproof penetrations in accordance with manufacturer's current procedures. Contact manufacturer for procedures at project conditions not provided for in installation manuals.

8. Protect membrane system from excessive rain.

9. Inspect and repair damage to membrane system immediately prior to shotcreting; ensure that concrete directly contacts membrane.

10. Complete waterproofing details and terminations at gradeline coordinating with work specified in other sections.

11. Termination Bars shall be installed over the top termination of the waterproofing composite sheets and affixed with fasteners set at 8 inch centers.

12. Stainless steel sheet metal counter flashings shall be provided over the top edge termination of the membrane assembly. Extend the bottom edge of the counterflashing minimum 4 inches below grade and overlap ends 4 inches minimum.

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Services:

1. Notify manufacturer prior to start of work and make arrangements for manufacturer's technical representative to be present during first day's work to verify work is being conducted in accordance with their recommendations.

2. Manufacturer is required to inspect finished installation prior to concrete placement.

3. Submit summary reports of Project site observations, instructions, monitoring activities, and report of waterproofing installation inspection immediately prior to concrete placement.

3.7 PROTECTION

A. Protect installed molded-sheet drainage panels and bentonite membrane during subsequent construction.

B. Protect installed waterproofing from precipitation and ground water with temporary polyethylene sheeting following procedures recommended by waterproofing manufacturer.

C. Remove polyethylene sheeting before placing concrete or shotcrete, or proceeding with subsequent construction.

D. Replace panels damaged by precipitation or which have expanded.

END OF SECTION

SECTION 071900 - WATER REPELLENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes penetrating water-repellents for the following non-traffic, vertical and horizontal exterior surfaces:
   1. Cast-in-place concrete.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each type of water repellent and substrate indicated.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of water repellent.

1.4 QUALITY ASSURANCE

A. Applicator Qualifications: An employer of workers trained and approved by manufacturer.

1.5 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 is not frozen and substrate-surface temperature is above 40 deg F and below 100 deg F.
   5. Rain or snow is not predicted within 24 hours.
   6. Not less than 24 hours 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.

PART 2 - PRODUCTS

2.1 PENETRATING WATER REPELLENTS

A. Silane, Penetrating Water Repellent: Clear, containing 40 percent or more solids of alkyltrialkoxysilanes; with alcohol, mineral spirits, water, or other proprietary solvent carrier; and with 400 g/L or less of VOCs.
   1. Basis-of-Design Product: Prosoco; SL100.
      a. Subject to compliance with requirements, manufacturers offering comparable products that may be incorporated into the Work include, but are not limited to, the following:
         1) BASF Corporation.
         2) Evonik Degussa Corporation.
         3) Fabrikem Manufacturing Ltd.
   2. Locations: Where indicated, and as follows:
      a. Cast-in-place concrete

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 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.

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.

C. 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.

D. 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. Apply coating of water repellent on surfaces to be treated using low-pressure spray to the point of saturation in number of coats and application rate recommended by manufacturer. Remove excess material; do not allow material to puddle beyond saturation. Comply with manufacturer's written instructions for application procedure unless otherwise indicated.

3.4 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.

B. Comply with manufacturer's written cleaning instructions.

END OF SECTION

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Continuous insulation.
a. At roof: Polyisocyanurate foam-plastic board insulation.
b. At wall:
1) Behind fiber cement: Mineral-wool board insulation.
2) Behind stucco: Mineral-wool board insulation
c. At curtainwall:
1) Mineral-wool board insulation.
2) Mineral-wool batt insulation.
2. Glass-fiber blanket insulation.

B. Related Sections:
1. Section 075216 “Styrene-Butadiene-Styrene (SBS) Modified Bituminous Membrane Roofing.”
2. Section 098100 "Acoustic Insulation" for sound attenuation insulation.
3. Division 22 and 23 Sections: For pipe and duct insulation.

1.2 ACTION SUBMITTALS

A. Product Data: For each product indicated.

B. Sustainable Design Submittals:
1. Laboratory Test Reports: For insulation, indicating compliance with requirements for low-emitting materials.

1.3 INFORMATIONAL SUBMITTALS

A. Installer's Certification: Listing type, manufacturer, and R-value of insulation installed in each element of the building thermal envelope.
1. Installer's certification is not required where individual insulation products are labeled with identification mark indicating R-value for each piece of insulation 12 inches and wider in width.
2. Sign, date, and post the certification in a conspicuous location on Project site.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

1.4 QUALITY ASSURANCE

A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sustainable Design Performance Requirements:
1. Insulation shall comply with the following:
a. Low-Emitting Materials: Testing and product requirements of the California Department of Health Services CDPH Standard Method v1.1, using CA Section 01350, Appendix B, New Single-Family Residence Scenario.

2.2 CONTINUOUS RAINSCREEN WALL INSULATION

A. Mineral-Wool Board Insulation, Unfaced: ASTM C612, Type IVB; passing ASTM E136 for combustion characteristics, with maximum flame-spread and smoke-developed indexes of 15 and 0, respectively.
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. Rockwool International; Cavityrock Black.
b. Thermafiber, Inc.; an Owens Corning company; RainBarrier Dark.
2. Compressive Strength: Minimum 435 lbs/sq. ft. at 10 percent deformation; ASTM C165.
3. Thermal Resistivity: Minimum 4.0 deg F x h x sq. ft./Btu x in. at 75 deg F.
4. Locations: Where indicated, and as follows:
a. Continuous insulation between exterior cladding and sheathing.

2.3 CONTINUOUS STUCCO WALL INSULATION

A. Mineral-Wool Board Insulation: ASTM C612, Type IVA; passing ASTM E136 for combustion characteristics, with maximum flame-spread and smoke-developed indexes of 15 and 0, respectively.
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. Rockwool International; Frontrock 80.
2. Compressive Strength: Minimum 940 lbs/sq. ft. at 10 percent deformation; ASTM C165.
3. Density: Minimum 8 lbs/cu. Ft.
4. Thermal Resistivity: Minimum 4.0 deg F x h x sq. ft./Btu x in. at 75 deg F; ASTM C518.
5. Locations: Where indicated, and as follows:
a. Continuous insulation between exterior cladding and sheathing.

2.4 CURTAINWALL INSULATION

A. Mineral-Wool Board Insulation, Unfaced: ASTM C612, Type IVB; passing ASTM E136 for combustion characteristics, with maximum flame-spread and smoke-developed indexes of 15 and 0, respectively.
   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. Rockwool International; Curtainrock 40.
      b. Thermafiber, Inc.; an Owens Corning company; Firespan 40.
   2. Compressive Strength: Minimum 435 lbs/sq. ft. at 10 percent deformation; ASTM C165
   3. Thermal Resistivity: Minimum 4.0 deg F x h x sq. ft./Btu x in. at 75 deg F.
   4. Locations: Where indicated, and as follows:
      a. Curtainwall assemblies spanning fire-rated floors.

B. Mineral-Wool Blanket Insulation, Unfaced: ASTM C665, Type I (blankets without membrane facing); consisting of fibers; complying with ASTM E136 for combustion characteristics.
   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. Rockwool International; Comfortbatt.
      b. Thermafiber, Inc.; an Owens Corning company; Fire & Sound Guard Plus.
   2. Locations: Where indicated, and as follows:
      a. Curtainwall assemblies spanning fire-rated floors.

2.5 CONTINUOUS ROOF INSULATION

A. Polyisocyanurate Board Insulation, Glass-Fiber-Mat Faced: ASTM C1289, glass-fiber-mat faced, Type II, Class 2.
   1. Locations: Where indicated, and as follows:
      a. Crickets: Continuous tapered insulation below roof membrane.

2.6 BLANKET INSULATION

A. Glass-Fiber Blanket Insulation, Unfaced: ASTM C665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.
   1. Products: Subject to compliance with requirements, provide the following:
      a. Johns Manville; Formaldehyde-free Unfaced thermal batts.
   2. Locations: Where indicated, and as follows:
      a. Cavities formed with framing members.
      b. Concealed spaces above ceilings greater than 6 inches.
   3. Insulation Value:
      a. Wall cavities: R-19.
      b. Roof cavities: R-30.

2.7 A CCESSORIES
   1. Continuous Wall Insulation

a. Fasteners and pressure plates
b. Perforated aluminum angle bottom edge protection

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

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. Install insulation with manufacturer's R-value label exposed after insulation is installed.

D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.2 INSTALLATION OF CONTINUOUS INSULATION

A. Subframing and Bracket Assemblies: Install assemblies with mechanical fasteners directly to substrate as recommended by manufacturer.
1. Place insulation in cavities formed by thermal isolation brackets to produce a friction fit between edges of insulation and adjoining brackets.

3.3 INSTALLATION OF BLANKET INSULATION

A. 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 wood-framed construction, install blankets according to ASTM C1320:

B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation.

END OF SECTION

SECTION 074213.13 - FORMED METAL WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Concealed-fastener, lap-seam metal wall panels at rooftop mechanical equipment screen.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.

C. Samples: For each type of metal panel indicated.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

B. Warranties: Samples of special warranties.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
1. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:
   1. Wind Loads: As indicated on Drawings.
   2. Other Design Loads: As indicated on Drawings.
   3. Deflection Limits: For wind loads, no greater than 1/180 of the span.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.2 CONCEALED-FASTENER, LAP-SEAM METAL WALL PANELS

A. Provide factory-formed metal panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.

B. Concealed-Fastener Formed Metal Wall Panels: Formed with a series of rectangular ribs.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Morin Matrix MX-14, or comparable product by one of the following:
      a. AEP Span.
      b. CENTRIA Architectural Systems.
   2. Aluminum sheet prepainted by the coil-coating process.
      a. Nominal Thickness: 0.034 inch.
      b. Exterior Finish: Two-coat fluoropolymer.
   3. Panel Coverage: 12 inches.
   4. Panel Height: 2.0 inch maximum.

C. Perforated Concealed-Fastener Formed Metal Wall Panels: Formed with a series of rectangular ribs and perforated.
   1. Location: Below level of parapet to allow air flow for rooftop mechanical units.

2.3 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 coating designation or ASTM A792/A792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
   1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
   2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
   3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
   4. Insect Screens: Provide at base of all rainscreen cavities and where indicated on Drawings.

C. Trim: Provide trim formed from same material as metal panels as required to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, caps, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
   1. Material: Stainless steel.

2.4 FABRICATION

A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

2.5 FINISHES

A. Panels and Accessories:
1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat.
a. Color: Matching Architect's sample:
1) UC106712XL Duranar XL Summer Suede Metallic (PPG).

PART 3 - EXECUTION

3.1 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.
1. Supports Material: Aluminum.

3.2 INSTALLATION

A. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
1. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
2. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
3. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.

B. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

C. Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated.

3.3 CLEANING

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

END OF SECTION

SECTION 074646 - FIBER-CEMENT SIDING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Fiber-cement siding and framing system.

B. Related Sections:
1. Section 072600 “Sheet Metal Flashing and Trim” for requirements for closure pieces and adjacent fabricated trim.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each product and finish proposed for use in the project including related accessories.

C. Shop Drawings:
1. Panel fabrication and layout.
2. Substructure layout with fasteners and accessories.
3. Include adjacent windows and flashings in details.
4. Signage penetrations and supports.
5. Provide stamped calculations for system as a whole including fasteners.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of fiber-cement siding.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fiber-cement siding.

C. Research/Evaluation Reports: For each type of fiber-cement siding required, from ICC-ES.

D. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of product, including related accessories, to include in maintenance manuals.

1.5 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
   1. Build mockup of conditions indicated complete, including support structure, attachments, underlayment, and accessories. May be combined with required mockups of adjacent systems.
      a. Typical shingled condition.
      b. Outside corner.
         1) Shingled to Shingled
         2) Shingled to Flush
      c. Inside corner.
         1) Shingled to Shingled
         2) Shingled to Flush
      d. Stucco transition.
   2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
   3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: 30 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 FIBER-CEMENT SIDING

A. General: ASTM C1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E136; with a flame-spread index of 25 or less when tested according to ASTM E84.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following :
      a. Equitone (Basis of Design: Tectiva, Linea, Natura, Pictura) ICC# ESR-3910
      b. Swiss Pearl IAPMO ER-0551
      c. Or equal.

B. Labeling: Provide fiber-cement siding that is tested and labeled according to ASTM C1186 by a qualified testing agency acceptable to authorities having jurisdiction.

C. Nominal Thickness: As follows:
   1. Panels: Not less than 7/16 inch.

D. Horizontal Pattern: Boards 7-1/4 to 7-1/2 inches wide in plainstyle.
   1. Texture: Smooth.

E. Panel: 48-inch- wide sheets.
1. Texture: Smooth.

F. Factory Color/Finish: Refer to Fiber Cement Panel schedule at end of this specification.

2.2 ACCESSORIES

A. Siding Accessories, General: Provide supports, edge trim, outside and inside corner profiles, perforated closure pieces and other items as recommended by siding manufacturer for building configuration.
1. Provide support basis of design or approved equal:
a. Universe 8000 series.
2. Supports to be prefinished black where visible behind fiber cement panels.

B. Flashing: Provide flashing complying with Section 076200 "Sheet Metal Flashing and Trim" at window and door heads and where indicated.

C. Fasteners:
1. As recommended and provided by manufacturer.
2. Finish color to match fiber cement panel.
a. Include touch up paint provided by manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.

B. Install support structure as recommended by manufacturer and as indicated.

C. Sand and seal cut edges according to manufacturer's written installation instructions.

3.2 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.

3.3 FIBER CEMENT SIDING SCHEDULE:

A. Provide Basis of Design products or approved equivalent. Locations and dimensions as indicated:
1. FC-A1 (Light):
a. Equitone Tectiva TE00

2. FC-A2 (Light Linear):
   a. Equitone Linea LT10
3. FC-B1 (Dark):
   a. Equitone Natura N250
4. FC-B2 (Dark Linear):
   a. Equitone Linea LT20
5. FC-C1 (Orange):
   a. Equitone Tectiva TE30
6. FC-C2 (Orange Linear):
   a. Equitone Linea LT30
7. FC-D (Window Recess):
   a. Equitone Natura N154
8. FC-E: (Corridors End):
   a. Equitone Natura N252
9. FC-F (Orange Slices):
   a. Equitone Pictura PG742

END OF SECTION

SECTION 075216 - STYRENE-BUTADIENE-STYRENE (SBS) MODIFIED BITUMINOUS MEMBRANE ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Styrene-butadiene-styrene (SBS) modified bituminous membrane roofing system.
   a. Base sheet.
   b. Cap sheet.
   c. Base flashing sheet.
2. Vapor barrier.
3. Accessory roofing system materials.
4. Vapor retarder.
5. Roof insulation.
6. Insulation accessories.
7. Cover board.
8. Walkways.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking, and for wood-based, structural-use roof deck panels.
2. Section 061600 "Sheathing" for wood-based, structural-use roof deck panels.
3. Section 061656 "Air-Barrier Water-Resistant Sheathing System" for vapor retarder components and interconnection with air barrier.
4. Section 072100 "THERMAL INSULATION" for board insulation part of roof assembly.
5. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
6. Section 077200 "Roof Accessories" for roof mounted products.
7. Section 077129 "Manufactured Roof Expansion Joints" for premanufactured roof expansion-joint assemblies.
8. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.
9. Section 221423 "Storm Drainage Piping Specialties" for roof drains.

1.2 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D1079 and glossary of NRCA's "Roofing Manual: Membrane Roof Systems" apply to Work of this Section.

1.3 PREINSTALLATION MEETINGS

A. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at Project site.

1. Meet with Owner's Representative, Architect, Owner's insurer if applicable, testing and inspecting agency representative, Roofing System Installer, roofing system

manufacturer's representative, deck Installer, air barrier Installer, and other installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.

2. Review methods and procedures related to roofing system installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review deck substrate requirements for conditions and finishes, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

B. Preinstallation Roofing Conference: Conduct conference at Project site.

1. Meet with Owner’s Representative, Architect, Owner's insurer if applicable, testing and inspecting agency representative, Roofing System Installer, roofing system manufacturer's representative, deck Installer, air barrier Installer, and other installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing system installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.

2. Base flashings and membrane terminations.
3. Flashing details at penetrations.
4. Tapered insulation, including slopes.
5. Roof plan showing orientation of roof deck and orientation of roofing membrane, and fastener spacings and pattern for corner, perimeter, and field-of-roof locations.
6. Crickets, saddles, and tapered edge strips, including slopes.
7. Tie-in with adjoining wall system air barrier.

C. Wind-Uplift Resistance Submittal: For roofing system indicating compliance with wind uplift performance requirements.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For roofing system Installer.

B. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roofing membrane manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

a. Submit evidence of complying with performance requirements.

2. Special Warranty Certificate: Signed by roofing membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

C. Product Test Reports: For roofing membrane and insulation, tests performed by a qualified testing agency, indicating compliance with specified requirements.

D. Evaluation Reports: For components of membrane roofing system, for tests performed by a qualified testing agency.

E. Field quality-control reports.

F. Sample warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

B. Certified statement from existing roofing system manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified firm that is approved, authorized, certified, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer.

1. Protect stored liquid material from direct sunlight.
2. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources.

1. Store in a dry location.
2. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed in accordance with manufacturer's written installation instructions and warranty requirements.

1.10 WARRANTY

A. Upon completion of the work, provide the Manufacturer's written and signed NDL Warranty, warranting that, if a leak develops in the roof during the term of this warranty, due either to defective material (membrane or flashing/accessories) or defective workmanship by the installing contractor, the manufacturer shall provide the Owner, at the Manufacturer's expense, with the labor and material necessary to return the defective area to a watertight condition.
1. Warranty Period:
    a. 30 years from date of acceptance.
    b. 5-year contractor warranty

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain components for roofing system from roofing membrane manufacturer or manufacturer approved by roofing membrane manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing system and flashings to 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 system and flashings to remain watertight.

1. Accelerated Weathering: Roofing membrane to withstand 2000 hours of exposure when tested in accordance with ASTM G152, ASTM G154, or ASTM G155.
2. Impact Resistance: Roofing membrane to resist impact damage when tested in accordance with ASTM D3746/D3746M, ASTM D4272/D4272M, or the "Resistance to Foot Traffic Test" section in FM Approvals 4470.

B. Material Compatibility: Roofing system materials to be compatible with one another and adjacent materials under conditions of service and installation required, as demonstrated by roofing membrane manufacturer based on testing and field experience.

C. Wind-Uplift Resistance: Design roofing system to resist the following wind-uplift pressures when tested in accordance with FM Approvals 4474, UL 580, or UL 1897.

D. Cool Roof Rating Council (CRRC): Roofing system to be listed by the CRRC for low-slope roof products.

E. Energy Performance: Roofing system to have an initial solar reflectance index (SRI) of not less than 0.70 and an emissivity of not less than 0.75 when tested in accordance with CRRC S100.

F. Exterior Fire-Test Exposure: Class A; for installation and roof slopes indicated; when tested by a qualified testing agency in accordance with ASTM E108 or UL 790.

1. Identify products with appropriate markings of applicable testing agency.

G. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated.

1. Identify products with appropriate markings of applicable testing agency.

2.3 STYRENE-BUTADIENE-STYRENE (SBS) MODIFIED BITUMINOUS MEMBRANE ROOFING SYSTEM

A. Roofing System Components: See the following articles for individual roof materials required for three-ply roofing system; self-adhered over mechanically fastened cover board installation method.

B. Provide system with components from one manufacturer, subject to the requirements of this section:
   1. Garland StressPly SA FR.
   2. Or approved equal.

2.4 BASE SHEET

A. SBS-Modified Bitumen Glass-Fiber-Mat Base Sheet: ASTM D6163/D6163M, Type I, Grade S, reinforced with glass fibers, smooth surfaced, suitable for installation method specified.

2.5 CAP SHEET

A. SBS-Modified Bitumen, Granule-Surfaced, Glass-Fiber-Mat Cap Sheet: ASTM D6163/D6163M, Type I, Grade G, SBS-modified asphalt sheet, reinforced with glass fibers, suitable for installation method specified.
   1. Granule Color: White or Highly reflective white.

2.6 BASE FLASHING SHEET

A. SBS-Modified Bitumen, Smooth-Surfaced Backer Sheet: Matching base sheet, suitable for installation method specified.

B. SBS-Modified Bitumen, Granule-Surfaced Base Flashing Sheet: Matching cap sheet, suitable for installation method specified.

2.7 VAPOR BARRIER AT ROOF DECK

A. Provide self-adhering vapor resistant system with components from one manufacturer, subject to the requirements of this section:
   1. Garland Vaporsmart SA.
   2. Or approved equal.

2.8 ACCESSORY ROOFING SYSTEM MATERIALS

A. General: Accessory materials as recommended in writing by roofing membrane manufacturer for intended use, compatible with other roofing components, and suitable for installation method specified.

   1. Adhesives and Sealants: Comply with VOC limits of authorities having jurisdiction.

B. Prefabricated Pipe Flashings: As recommended in writing by roofing membrane manufacturer.

C. Roof Vents: As recommended in writing by roofing membrane manufacturer.

   1. Size: Not less than 4-inch (100-mm) diameter.

D. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.

E. Cold-Applied Polymer-Modified Asphalt Adhesive: Roofing membrane manufacturer's standard solvent- and asbestos-free, cold-applied adhesive, specially formulated for compatibility and use with roofing membrane sheets and base flashing sheets; designed for adhering roofing system components to substrate and each other, tested by roofing system manufacturer to meet performance requirements.

F. Mastic Sealant: Polyisobutylene, plain or modified bitumen; nonhardening, nonmigrating, nonskinning, and nondrying.

G. Self-Adhered Primer: Roofing membrane manufacturer's standard primer to enhance the adhesion of membrane to substrate.

H. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate; tested for required pullout strength, and acceptable to roofing membrane manufacturer.

I. Roofing Granules: Roofing membrane manufacturer's standard ceramic-coated mineral roofing granules, No. 11 screen size with 100 percent passing No. 8 (2.36-mm) sieve and 98 percent of mass retained on No. 40 (0.425-mm) sieve; color matching cap sheet.

J. Safety Accessories: Roofing membrane manufacturer's standard yellow seaming tape for designating safety perimeters and rooftop hazards.

K. Miscellaneous Accessories: As recommended in writing by roofing membrane manufacturer.

2.9 VAPOR RETARDER

1. Fluid-applied vapor retarder flashing.
2. Vapor retarder sealant.
    a. Backer rod.

2.10 ROOF INSULATION

A. General: Preformed roof insulation boards, manufactured or approved by roofing membrane manufacturer.

1. Refer to Section 072100 THERMAL INSULATION.

B. Tapered Insulation: Provide factory-tapered insulation boards.

1. Material: Match roof insulation.
2. Minimum Thickness: 1/4 inch (6 mm).
3. Slope:

    a. Roof Field: 1/4 inch per foot (1:48) unless otherwise indicated on Drawings.

b. Saddles and Crickets: 1/2 inch per foot (1:24) unless otherwise indicated on Drawings.

2.11 INSULATION ACCESSORIES

A. General: Roof insulation accessories as recommended in writing by roof membrane manufacturer for intended use, compatible with other roofing system components and suitable for installation method specified.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation to substrate, and acceptable to roofing membrane manufacturer.

C. Insulation Cant Strips: ASTM C208, Type II, Grade 1, cellulosic-fiber insulation board.

D. Wood Nailer Strips: Comply with requirements in Section 061000 "Rough Carpentry."

E. Tapered Edge Strips: ASTM C208, Type II, Grade 1, cellulosic-fiber insulation board.

2.12 COVER BOARD

A. General: Cover board as recommended in writing by roof membrane manufacturer for intended use; compatible with other roofing system components and suitable for installation method specified.

B. Glass-Mat Gypsum Cover Board: ASTM C1177/C1177M, water-resistant gypsum board.
1. Thickness: 1/2 inch (12 mm).
2. Surface Finish: Factory primed.

2.13 WALKWAYS

A. Walkway Pads: Polymer-modified, reconstituted rubber pads with slip-resisting textured surface, manufactured as a traffic pad for foot traffic and acceptable to roofing membrane manufacturer.

1. Pad Size: Approximately 36 by 60 inches (914 mm by 1524 mm)
2. Color: Contrasting with cap sheet as selected by Owner.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Roofing System 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 wood cants, blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
3. Verify that deck is securely fastened with no projecting fasteners and with no adjacent units in excess of 1/16 inch (1.6 mm) out of plane relative to adjoining deck.
4. Verify that all deck penetrations are in place and complete.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation in accordance with roofing system manufacturer's written instructions.

1. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction.

1. Remove roof-drain plugs when no work is taking place or when rain is forecast.

3.3 INSTALLATION OF ROOFING, GENERAL

A. Complete terminations and base flashings. Provide temporary seals to prevent water from entering completed sections of roofing system at the end of workday or when rain is forecast.

1. Remove and discard temporary seals before beginning work on adjoining roofing.

B. Coordinate installation and transition of roofing system component serving as an air barrier with wall system air barrier specified in Section 061656 “Air-Barrier Water-Resistant Sheathing System.”

3.4 INSTALLATION OF VAPOR RETARDER

A. Apply fluid-applied vapor retarder to joints in substrate.

B. Apply backer rod and fluid-applied vapor retarder sealant to all other roof penetrations.

3.5 INSTALLATION OF INSULATION

A. Coordinate installation of roofing system components, so insulation is not exposed to precipitation or left exposed at end of workday.

B. Comply with roofing system and insulation manufacturer's written installation instructions. Install minimum of two layers of insulation under area of roofing to achieve required thickness.

C. Install each layer of insulation with joints staggered not less than 24 inches (600 mm) in adjacent rows and offset not less than 12 inches (300 mm) from previous layer.

1. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
2. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
3. At internal roof drains, slope insulation to create a square drain sump, with each side equal to the diameter of the drain bowl plus 24 inches (600 mm).
4. Trim insulation, so that water flow is unrestricted.
5. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
6. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
7. Secure insulation to resist specified uplift pressure at corners, perimeter, and field of roof.

D. Insulation Cant Strips: Install and secure preformed 45-degree insulation cant strips at junctures of roofing system with vertical surfaces or angle changes greater than 45 degrees.

3.6 INSTALLATION OF COVER BOARD

A. Comply with roofing system and insulation manufacturer's written installation instructions.

B. Fasten to substrate as indicated in drawings by wind-uplift zone.

C. Install cover board 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 (150 mm) in each direction.

1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
2. At internal roof drains, conform to slope of drain sump.
3. Trim cover board, so that water flow is unrestricted.
4. Cut and fit cover board tight to nailers, projections, and penetrations.
5. Secure cover board to resist specified uplift pressure at corners, perimeter, and field of roof.

3.7 INSTALLATION OF ROOFING MEMBRANE, GENERAL

A. Install roofing system in accordance with roofing system manufacturer's written installation instructions and applicable recommendations in NRCA's "Quality-Control Guidelines for the Application of Polymer-Modified Bitumen Roofing."

B. Start installation of roofing in presence of roofing system manufacturer's technical personnel.

C. Where roof slope exceeds 1/2 inch per 12 inches (1:24), install roofing membrane sheets parallel with slope.

D. Coordinate installation of roofing system so insulation and other components of roofing system not permanently exposed are not subjected to precipitation or left uncovered at end of workday or when rain is forecast.

1. Provide tie-offs at end of each day's work to cover exposed roofing sheets and insulation with a course of coated felt set in adhesive, with joints and edges sealed.
2. Complete terminations and base flashings, and provide temporary seals to prevent water from entering completed sections of roofing system.
3. Remove and discard temporary seals before beginning work on adjoining roofing.

3.8 INSTALLATION OF BASE SHEET

A. Prime surface of substrate with primer in accordance with roofing membrane manufacturer's written installation instructions and allow primer to dry.

B. Before installing, unroll base sheet, cut into workable lengths, and allow to lie flat for a time period recommended by roofing membrane manufacturer for the ambient temperature at which base sheet will be installed.

C. Loosely lay one course of sheathing paper, lapping edges, and ends a minimum of 2 inches (51 mm) and 6 inches (150 mm), respectively.

D. Installation of Base Sheet:

1. Install base sheet in accordance with roofing membrane manufacturer's written installation instructions, starting at low point of roof.
2. Extend base sheet over and terminate above cants.
3. Install base sheet in a shingle fashion.

4. Mechanically fasten base sheet to substrate using fasteners specifically designed and sized for wood decks.

    a. Fasten base sheet to resist specified uplift pressure at corners, perimeter, and field of roof.

5. Install base sheet without wrinkles or rears, and free from air pockets.
6. Laps: Accurately align base sheet, without stretching, and maintain uniform side and end laps.

    a. Lap side laps as recommended by roofing membrane manufacturer but not less than 3 inches (76 mm).
    b. Lap end laps as recommended by roofing membrane manufacturer but not less than 12 inches (300 mm). Stagger end laps not less than 18 inches (450 mm).
    c. Completely bond and seal laps, leaving no voids.
    d. Roll laps with a 20 lb (9 kg) roller.

7. Repair tears and voids in laps and lapped seams not completely sealed.
8. Apply pressure to body of base sheet in accordance with roofing membrane manufacturer's written installation instructions, to remove air pockets and to result in complete adhesion of base sheet to substrate.

3.9 INSTALLATION OF CAP SHEET

A. Before installing, unroll cap sheet, cut into workable lengths, and allow to lie flat for a time period recommended by roofing membrane manufacturer for the ambient temperature at which cap sheet will be installed.

B. Install cap sheet in accordance with roofing membrane manufacturer's written installation instructions, starting at low point of roof.

1. Extend cap sheet over and terminate above cants.
2. Install cap sheet in a shingle fashion.
3. Adhere cap sheet to previous layer in a uniform coating of cold-applied adhesive.
4. Self-adhere cap sheet to bottom layer.

5. Install cap sheet without wrinkles or tears, and free from air pockets.
6. Install cap sheet so side and end laps shed water.

C. Laps: Accurately align roof sheets, without stretching, and maintain uniform side and end laps.

1. Lap side laps as recommended by roofing membrane manufacturer but not less than 3 inches (76 mm).
2. Lap end laps as recommended by roofing membrane manufacturer but not less than 12 inches (300 mm). Stagger end laps not less than 18 inches (450 mm).
3. Completely bond and seal laps, leaving no voids.
4. Roll laps with a 20 lb (9 kg) roller.
5. Repair tears and voids in laps and lapped seams not completely sealed.

D. Apply pressure to body of cap sheet in accordance with roofing membrane manufacturer's written installation instructions, to remove air pockets and result in complete adhesion of cap sheet to substrate.

E. Apply roofing granules of same color as cap sheet to cover exuded bead at laps while bead is hot, to provide a continuous color appearance.

3.10 INSTALLATION OF BASE FLASHING AND STRIPPING

A. Install base flashing sheet over cant strips and other sloped and vertical surfaces, at roof edges, and at penetrations through roof, and secure to substrates in accordance with roofing system manufacturer's written installation instructions and as follows:
1. Backer Sheet Installation: Mechanically fasten backer sheet to walls or parapets. Adhere backer sheet over roofing membrane at cants. Adhere backer sheet to substrate in a uniform layer of cold-applied adhesive.

2. Base Flashing Sheet Installation, Cold: Adhere base flashing sheet to substrate in cold-applied adhesive at rate required by roofing system manufacturer.

B. Extend base flashing sheet up walls or parapets a minimum of 8 inches (200 mm) above roofing membrane and 4 inches (100 mm) onto field of roofing membrane.

C. Mechanically fasten top of base flashing sheet securely at terminations and perimeter of roof.

1. Seal top termination of base flashing sheet.

D. Install liquid flashing system in accordance with roofing system manufacturer's written installation instructions.

1. Extend liquid flashing not less than 3 inches (76 mm) in all directions from edges of item being flashed.
2. Embed granules, matching color of cap sheet, into wet compound.

E. Roof Drains: Set 30-by-30-inch- (762-by-762-mm-) 4 lb (1.8 kg) flashing in bed of adhesive on completed roofing membrane.

1. Cover flashing with cap sheet stripping, and extend a minimum of 6 inches (150 mm) beyond edge of metal flashing onto field of roofing membrane.
2. Clamp roofing membrane, metal flashing, and stripping into roof-drain clamping ring.
3. Install stripping in accordance with roofing system manufacturer's written installation instructions.

3.11 INSTALLATION OF WALKWAYS

A. Walkway Pads: Install walkway pads using units of size indicated or, if not indicated, of manufacturer's standard size; secure to cap sheet in accordance with roofing system manufacturer's written installation instructions.

1. Install walkways at the following locations:

a. Perimeter of each rooftop unit.
b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
d. Top and bottom of each roof access ladder.
e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
f. Locations indicated on Drawings.
g. As required by roofing system manufacturer's warranty requirements.

2. Provide 3-inch (76-mm) clearance between adjoining pads.

3.12 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to inspect substrate conditions, surface preparation, roofing membrane installation, flashings, protection, and drainage components, and to furnish reports to Architect.

B. Perform the following tests:

1. Flood Testing: Flood test each roof area for leaks, in accordance with recommendations in ASTM D5957, after completing roofing and flashing but before overlying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.

    a. Perform tests before overlying construction is placed.
    b. Flood to an average depth of 2-1/2 inches (65 mm) with a minimum depth of 1 inch (25 mm) and not exceeding a depth of 4 inches (100 mm). Maintain 2 inches (51 mm) of clearance from top of base flashing.
    c. Flood each area for 24 hours.
    d. After flood testing, repair leaks, repeat flood tests, and make further repairs until roofing and flashing installations are watertight.

        1) Cost of retesting is Contractor's responsibility.

    e. Testing agency to prepare survey report indicating locations of initial leaks, if any, and final survey report.

2. Infrared Thermography: Testing agency surveys entire roof area using infrared color thermography in accordance with ASTM C1153.

    a. Perform tests before overlying construction is placed.
    b. After infrared scan, locate specific areas of leaks by electrical capacitance/impedance testing, or by nuclear hydrogen detection testing.
    c. After testing, repair leaks, repeat tests, and make further repairs until roofing and flashing installations are watertight.

        1) Cost of retesting is Contractor's responsibility.

    d. Testing agency to prepare survey report of initial scan indicating locations of entrapped moisture if any.

C. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.

    1. Notify Architect and Owner 48 hours in advance of date and time of inspection.

D. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

E. Roofing system will be considered defective if it does not pass tests and inspections.

    1. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.13 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period.

1. When remaining construction does not affect or endanger roofing, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove 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 in accordance with warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.14 ROOFING SYSTEM INSTALLER'S WARRANTY

A. WHEREAS _____ of _____, herein called the "Roofing System Installer," has performed roofing and associated Work on the following Project:

1. Owner: <**Insert name of Owner**>.
2. Owner Address: <**Insert address**>.
3. Building Name/Type: <**Insert information**>.
4. Building Address: <**Insert address**>.
5. Area of Work: <**Insert information**>.
6. Warranty Period: [**Two**] [**Five**] <**Insert number**> years from date of Substantial Completion..
7. Date of Substantial Completion: _____.

B. AND WHEREAS Roofing System Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said Work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

C. NOW THEREFORE Roofing System Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period Roofing System Installer will, at Roofing System Installer's own cost and expense, make or cause to be made such repairs to or replacements of said Work as are necessary to correct faulty and defective Work and as are necessary to maintain said Work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:

a. lightning;
b. peak gust wind speed exceeding 93 miles per hour;
c. fire;
d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the Work;
f. vapor condensation on bottom of roofing; and

g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.

2. When Work has been damaged by any of foregoing causes, Warranty will be null and void until such damage has been repaired by Roofing System Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
3. Roofing System Installer is responsible for damage to Work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of Work.
4. During Warranty Period, if Owner allows alteration of Work by anyone other than Roofing System Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty will become null and void on date of said alterations, but only to the extent said alterations affect Work covered by this Warranty. If Owner engages Roofing System Installer to perform said alterations, Warranty will not become null and void unless Roofing System Installer, before starting said Work, will have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate Work, thereby reasonably justifying a limitation or termination of this Warranty.
5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty will become null and void on date of said change, but only to the extent said change affects Work covered by this Warranty.
6. Owner will promptly notify Roofing System Installer of observed, known, or suspected leaks, defects, or deterioration and afford reasonable opportunity for Roofing System Installer to inspect Work to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing System Installer on said Work and will not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty will not operate to relieve Roofing System Installer of responsibility for performance of original Work in accordance with requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this _____ day of _____, _____.

1. Authorized Signature: _____.
2. Name: _____.
3. Title: _____.

END OF SECTION 075216

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Formed sheet metal fabrications as indicated including:
a. Flashing
b. Gutters
c. Scuppers
d. Downspouts
e. Roof edge flashing
f. CLT slab edge flashing
g. Flashing of projection around curtain wall
2. High temperature underlayments.

B. Related Sections:
1. Section 071326 “Self-Adhering Sheet Flashing” for non-sheet metal flashings.
2. Section 075423 “075216 - Styrene-Butadiene-Styrene (SBS) Modified Bituminous Membrane Roofing” for manufacturer edge metal requirements.

1.2 ACTION SUBMITTALS

A. Product Data: For each of product indicated.

B. 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, joining, supporting, and securing flashing and sheet metal, including pattern of seams, termination points, fixed points, expansion joints, expansion-joint covers, edge conditions, special conditions, and connections to adjoining work

C. Samples: For each exposed product and for each color and texture specified, 12 inches long by actual width.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

1.5 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
   1. Build mockup of conditions indicated, approximately 10 ft. (3.0 m) long unless otherwise indicated, including supporting construction cleats, seams, attachments, underlayment, and accessories.
      a. Roof edge and gutter at entry roof overhang.
      b. Roof scupper.
      c. CLT slab edge metal.
      d. Demonstration of sheet metals and transitions for projection around curtainwall, minimum practicable size, list below can be combined:
         1) Top to side corner
         2) Top to top corner
         3) Side to bottom corner
         4) Bottom to bottom corner
      e. Flashings and transitions at shingled fiber cement panels, no maximum size requirement, integrate fiber cement panels into mock-up(s):
         1) Outer corner
         2) Inner corner
         3) Through wall louver flashing
         4) Vertical window spandrel trim
   2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
   3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 WARRANTY

A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
      b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
      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. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 SHEET METALS

A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Aluminum Sheet: Coil-coated sheet, ASTM B209/B209M, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
   1. Surface: Smooth, flat.
   2. Thickness:
      a. At exposed applications and coping caps: 0.040 inches.
      b. At concealed applications: 0.032 inches.
   3. Exposed Coil-Coated Finish: Unless indicated otherwise.
      a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (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.
      b. Color: As selected by Architect, match adjacent finishes or provide from manufacturer's full range.
      c. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

C. Stainless Steel Sheet: ASTM A240/A240M, Type 304, dead soft, fully annealed; with smooth, flat surface.
   1. Finish: ASTM A480/A480M, No. 2D (dull, cold rolled).

D. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet in accordance with ASTM A653/A653M, G90 coating designation; prepainted by coil-coating process to comply with ASTM A755/A755M.
   1. Surface: Smooth, flat.
   2. Exposed Coil-Coated Finish: Unless indicated otherwise.
      a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (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.
      b. Color: As selected by Architect, match adjacent finishes or provide from manufacturer's full range.
      c. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet Underlayment/Vapor Retarder: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer in accordance with underlayment manufacturer's written instructions.
   1. Products: Subject to compliance with requirements and compatible with air barrier and other flashings, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Carlisle WIP Products; a brand of Carlisle Construction Materials; WIP 300HT.
      b. GCP Applied Technologies Inc.; Grace Ice and Water Shield HT.
      c. Henry Company; Blueskin PE200 HT.
      d. Metal-Fab Manufacturing, a Drexel Metals Company; MetShield.
      e. Owens Corning; WeatherLock Metal High-Temperature Underlayment.
      f. Protecto Wrap Company; Protecto Jiffy Seal Ice & Water Guard HT.
      g. SDP Advanced Polymer Products Inc; Palisade SA-HT.
   2. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F or lower.
   3. Vapor Permeability: 0.02 perms or less.

2.4 MISCELLANEOUS MATERIALS

A. Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.
   1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.

a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
b. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.

2. Fasteners for 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: Series 300 stainless steel or hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329.

C. Solder:
1. For Stainless Steel: ASTM B32, Grade Sn60, with acid flux of type recommended by stainless steel sheet manufacturer.

D. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

E. Elastomeric Sealant: ASTM C920, elastomeric polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

F. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

G. Bituminous Coating: Cold-applied asphalt emulsion in accordance with ASTM D1187/D1187M.

2.5 FABRICATION, GENERAL

A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.
1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
2. 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.
3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances:
1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings

and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

2. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.

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.
2. Use lapped expansion joints only where indicated on Drawings.

D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.

E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

F. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.

G. Seams:
1. Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
2. Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.

2.6 ROOF-DRAINAGE SHEET METAL FABRICATIONS

A. Hanging Gutters:
a. Aluminum: 0.050 inch thick.
2. Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required.
3. Fabricate in full-length sections.
4. Furnish flat-stock gutter brackets and flat-stock gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard, but with thickness not less than twice the gutter thickness.
5. Fabricate gutter accessories from same metal as gutters. Shop fabricate interior and exterior corners.
6. Gutter Profile: Style B in accordance with cited sheet metal standard.
7. Accessories: Continuous, removable leaf screen with sheet metal frame and hardware cloth screen.

B. Downspouts: Fabricate round downspouts to dimensions indicated on Drawings, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors. Shop fabricate elbows.
1. Fabricate from the following materials:
a. Aluminum: 0.050 inch thick.
1) Within 8' of grade: 0.064 inch thick.

C. Parapet Scuppers: Fabricate scuppers to dimensions required, with closure flange trim to exterior, 4-inch- wide wall flanges to interior, and base extending 4 inches beyond cant or tapered strip into field of roof. Fabricate from the following materials:
   1. Aluminum: 0.050 inch thick.

D. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape required, complete with outlet tubes, exterior flange trim, and built-in overflows. Fabricate from the following materials:
   1. Aluminum: 0.050 inch thick.

E. Roof-Drain Flashing: Fabricate from the following materials:
   1. Stainless Steel: 0.025 inch thick.

2.7 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Copings: Fabricate in minimum 96-inch- long, but not exceeding 12-foot- long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and interior leg. Miter corners, solder or weld watertight. Shop fabricate interior and exterior corners.
   1. Fabricate from the following materials:
      a. Aluminum: 0.050 inch thick.

B. Counterflashing: Fabricate from the following materials:
   1. Aluminum: 0.050 inch thick.

2.8 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch- long, but not exceeding 12-foot- long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings; and form with 2-inch- high, end dams. Fabricate from the following materials:
   1. Aluminum: 0.050 inch thick.

B. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch- high, end dams. Fabricate from the following materials:
   1. Aluminum: 0.050 inch thick.

C. Below Grade Base Flashing: Fabricate from the following materials:
   1. Stainless Steel: 0.025 inch thick.

D. Above Grade Exposed Flashings: Fabricate from the following materials:
   1. Aluminum: 0.050 inch thick.

E. Claddings and Fascias: Fabricate from the following materials:
   1. Aluminum: 0.050 inch thick.

PART 3 - EXECUTION

3.1 INSTALLATION OF UNDERLAYMENT

A. Self-Adhering, High-Temperature Sheet Underlayment:
1. Install self-adhering, high-temperature sheet underlayment; wrinkle free.
2. Prime substrate if recommended by underlayment manufacturer.
3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
4. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses.
5. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller.
6. Roll laps and edges with roller.
7. Cover underlayment within 14 days.

3.2 INSTALLATION, GENERAL

A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.
1. Install fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, orsealant.
3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
5. Space individual cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
6. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
7. Do not field cut sheet metal flashing and trim by torch.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
1. Coat concealed side of stainless steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.
1. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.

2. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
3. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction.
1. Use sealant-filled joints unless otherwise indicated.
   a. Embed hooked flanges of joint members not less than 1 inch into sealant.
   b. Form joints to completely conceal sealant.
   c. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way.
   d. Adjust setting proportionately for installation at higher ambient temperatures.
      1) Do not install sealant-type joints at temperatures below 40 deg F.
2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter.
1. Pretin edges of sheets with solder to width of 1-1/2 inches; however, reduce pretinning where pretinned surface would show in completed Work.
2. Do not solder metallic-coated steel sheet.
3. Do not use torches for soldering.
4. Heat surfaces to receive solder, and flow solder into joint.
   a. Fill joint completely.
   b. Completely remove flux and spatter from exposed surfaces.
5. Stainless Steel Soldering:
   a. Tin edges of uncoated sheets, using solder for stainless steel and acid flux.
   b. Promptly remove acid-flux residue from metal after tinning and soldering.
   c. Comply with solder manufacturer's recommended methods for cleaning and neutralization.

3.3 INSTALLATION OF ROOF-DRAINAGE SYSTEM

A. Install sheet metal roof-drainage items to produce complete roof-drainage system in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.

B. Downspouts:
1. Join sections with 1-1/2-inch telescoping joints.
2. Provide hangers with fasteners designed to hold downspouts securely to walls.
3. Locate hangers at top and bottom and at approximately 60 inches o.c.
4. Provide elbows at base of downspout to direct water away from building.
5. Connect downspouts to underground drainage system.

C. Parapet Scuppers:
1. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.
2. Anchor scupper closure trim flange to exterior wall and seal with elastomeric sealant to scupper.
3. Loosely lock front edge of scupper with conductor head.
4. seal with elastomeric sealant exterior wall scupper flanges into back of conductor head.

D. Conductor Heads: Anchor securely to wall, with elevation of conductor head rim at minimum of 1 inch below scupper discharge.

3.4 INSTALLATION OF ROOF FLASHINGS

A. Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard.
1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Copings:
1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.
2. Anchor to resist uplift and outward forces in accordance with recommendations in cited sheet metal standard unless otherwise indicated.
   a. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 24-inch centers.
   b. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 24-inch centers.
3. Anchor to resist uplift and outward forces in accordance with recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for specified FM Approvals' listing for required windstorm classification.

3.5 INSTALLATION OF WALL FLASHINGS

A. Install sheet metal wall flashing to intercept and exclude penetrating moisture in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings.

C. Where flashing extends below grade, install continuous bead of sealant at bottom of flashing and at overlapping edges. Overlap edges minimum 6 inches.

3.6 INSTALLATION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.7 CLEANING

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.

3.8 PROTECTION

A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

B. 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, as determined by Architect.

END OF SECTION

SECTION 077129 - MANUFACTURED ROOF EXPANSION JOINTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Aluminum roof expansion joints.
      a. With thermal vapor barrier.

B. Related Requirements:

   1. Section 061000 "Rough Carpentry" for wooden curbs or cants for mounting roof expansion joints.
   2. Section 076200 "Sheet Metal Flashing and Trim" for shop- and field-fabricated sheet metal expansion-joint systems, flashing, and other sheet metal items.
   3. Section 079513.13 “Interior Expansion Joint Cover Assemblies.”
   4. Section 079513.16 “Exterior Expansion Joint Cover Assemblies.”

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data:
   1. Aluminum roof expansion joints.
      a. And thermal vapor barrier.

B. Shop Drawings: For roof expansion joints.

   1. Include plans, elevations, sections, and attachment details.
   2. Include details of splices, intersections, transitions, fittings, method of field assembly, and location and size of each field splice.
   3. Provide isometric drawings of intersections, terminations, changes in joint direction or planes, and transition to other expansion joint systems depicting how components interconnect with each other and adjacent construction to allow movement and achieve waterproof continuity.

C. Samples: For each exposed product and for each color specified, 6 inches (150 mm) in size.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE:

A. Manufacturer: Furnish assemblies from one manufacturer with a minimum of five years experience in the design and fabrication of expansion joint cover assemblies.

B. Installer: Firm with a minimum of five years experience in installation of systems similar to those required by this project and acceptable to manufacturer.

1.6 WARRANTY

A. Special Warranty: Manufacturer and Installer agree to repair or replace roof expansion joints and components that leak, deteriorate beyond normal weathering, or otherwise fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. 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 seals, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 ALUMINUM ROOF EXPANSION JOINTS

A. Aluminum Roof Expansion Joint **at Level 1 Roof**: Factory-fabricated, continuous, waterproof, joint cover; consisting of a formed or extruded metal cover secured to extruded aluminum frames, with water-resistant gasketing between cover and frames, and with provision for securing assembly to substrate and sealing assembly to roofing membrane or flashing.

1. Provide the basis of design product or approved equivalent:
   a. MM Systems, SMR-12-8
      1) With IVB-1200-R30 thermal vapor barrier.
         a) Insulating value: R-30 minimum.
2. Joint Movement Capability:
   a. Seismic Movement:
      1) Seismic Gap: 8 inches.
      2) Nominal Joint Width: 12 inches.
      3) Minimum Joint Width: 4 inches.

4) Maximum Joint Width: 24 inches.

3. Frame Members: Extruded aluminum configured for curbs as indicated; with exposed finish matching cover.
4. Cover: Formed aluminum; thickness **as recommended by manufacturer**.
5. Corner, Intersection, and Transition Units: When available, provide factory-fabricated units for corner and joint intersections and horizontal and vertical transitions including those to other building expansion joints. Else, fabricate necessary transition pieces from aluminum matching finish of visible adjacent materials.
6. Accessories: Provide splicing units, adhesives, and other components as recommended by roof-expansion-joint manufacturer for complete installation.
7. Secondary Seal: Continuous, waterproof membrane within joint and attached to substrate on sides of joint below the cover.
   a. Slope seal to shed water.

B. Aluminum Roof Expansion Joint **at Level 3 Roof**: Factory-fabricated, continuous, waterproof, joint cover; consisting of a formed or extruded metal cover secured to extruded aluminum frames, with water-resistant gasketing between cover and frames, and with provision for securing assembly to substrate and sealing assembly to roofing membrane or flashing.

1. Provide the basis of design product or approved equivalent:
   a. MM Systems, SMR-12-8
      1) With IVB-1200-R30 thermal vapor barrier.
         a) Insulating value: R-30 minimum.
2. Joint Movement Capability:
   a. Seismic Movement:
      1) Seismic Gap: 8 inches.
      2) Nominal Joint Width: 12 inches.
      3) Minimum Joint Width: 4 inches.
      4) Maximum Joint Width: 24 inches.
3. Frame Members: Extruded aluminum configured for curbs as indicated; with exposed finish matching cover.
4. Cover: Formed aluminum; thickness as recommended by manufacturer for **foot traffic loads**.
5. Corner, Intersection, and Transition Units: When available, provide factory-fabricated units for corner and joint intersections and horizontal and vertical transitions including those to other building expansion joints. Else, fabricate necessary transition pieces from aluminum matching finish of visible adjacent materials.
6. Accessories: Provide splicing units, adhesives, and other components as recommended by roof-expansion-joint manufacturer for complete installation.
7. Secondary Seal: Continuous, waterproof membrane within joint and attached to substrate on sides of joint below the cover.
   a. Slope seal to shed water.

C. Materials:

1. Aluminum: ASTM B209 (ASTM B209M) for sheet and plate, ASTM B221 (ASTM B221M) for extrusions; alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.

2.3 FINISHES

A. Exposed Metal: Prefinished aluminum:
1. Pretreatment: Provide factory applied seven-step chromate conversion coating for application of field-applied paints.
2. Fluoropolymer coating system: Super-cote I.
3. Two-coat, shop-applied, baked-on 70% fluoropolymer coating system based on Elf Atochem, Inc., Kynar 500 or Ausimont U.S.A., Inc., Hylar 5000 resin (polyvinylidene fluoride, PVDF), formulated by a licensed manufacturer and applied by manufacturer's approved applicator, to meet AAMA 605.2-90.
4. Coating system shall provide minimum 1.2 mil dry film thickness consisting of 0.2 to 0.4 mil primer and minimum 1.0 mil color coat, baked on at 450 degrees F. metal temperature.
5. Color: Custom color as selected by Architect.

2.4 MISCELLANEOUS MATERIALS

A. Adhesives: As recommended by roof-expansion-joint manufacturer in compliance with CARB VOC limits.

B. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to withstand design loads.

1. Exposed Fasteners: Gasketed. Use screws with hex washer heads matching color of material being fastened.

C. Mineral-Fiber Blanket: ASTM C665.

D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joint openings, substrates, and expansion-control joint systems that interface with roof expansion joints, for suitable conditions where roof expansion joints will be installed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSPECTION

A. Prior to installation of cover assembly, coordinate inspection of thermal and vapor barrier by Project Inspector.

3.3 INSTALLATION, GENERAL

A. Comply with manufacturer's written instructions for handling and installing roof expansion joints.

1. Anchor roof expansion joints securely in place, with provisions for required movement. Use fasteners, protective coatings, sealants, and miscellaneous items as required to complete roof expansion joints.
2. Install roof expansion joints true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
3. Provide for linear thermal expansion of roof-expansion-joint materials.
4. Provide uniform profile of roof expansion joint throughout its length; do not stretch or squeeze membranes.
5. Provide uniform, neat seams.
6. Install roof expansion joints to fit substrates and to result in watertight performance.

B. Directional Changes: Install factory-fabricated units at directional changes to provide continuous, uninterrupted, and watertight joints.

C. Transitions to Other Expansion-Control Joint Assemblies: Coordinate installation of roof expansion joints with other exterior expansion-control joint assemblies specified in Section 079513.16 "Exterior Expansion Joint Cover Assemblies" to result in watertight performance. Install factory-fabricated units at transitions between roof expansion joints and exterior expansion-control joint systems.

D. Splices: Splice roof expansion joints to provide continuous, uninterrupted, and waterproof joints.

1. Install waterproof splices and prefabricated end dams to prevent leakage of secondary-seal membrane.

E. 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.

END OF SECTION 077129

SECTION 077200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Roof hatches and accessories.
a. Guards
b. Ladders
2. Roof mounted crane and winch.

B. Related Sections:
1. Section 076200 "Sheet Metal Flashing and Trim" for shop- and field-formed metal flashing, roof-drainage systems, roof expansion-joint covers, and miscellaneous sheet metal trim and accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of roof accessory.

B. Shop Drawings: For roof accessories.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:
1. Size and location of roof accessories specified in this Section.
2. Method of attaching roof accessories to roof or building structure.
3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.
4. Required clearances.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

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.

2.2 ROOF HATCHES

A. Roof Hatches: Metal roof-hatch units with lids and insulated double-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, stepped integral metal cant raised the thickness of roof insulation, and integrally formed deck-mounting flange at perimeter bottom.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide the following:
      a. Bilco Company (The); Type S-50TB Roof Hatch.

B. Type and Size: Single-leaf lid, 30 by 36 inches.
   1. Lift assistance – compression spring operators enclosed in telescopic tubes.
   2. Automatic hold-open arm with grip handle release.

C. Curb, Framing, and Lid Material: Aluminum sheet 11 gauge.
   1. Thickness: Manufacturer's standard thickness for hatch size indicated.
   2. Finish: Mill.

D. Construction:
   1. Insulation: polyisocyanurate board.
   2. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
   3. Exterior Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
   4. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.
   5. Sloping Roofs: Where slope or roof deck exceeds 1:48, fabricate curb with perimeter curb height that is constant. Equip hatch with water diverter or cricket on side that obstructs water flow.

E. Hardware: Manufacturer's standard stainless steel; with hinges, hold-open devices, and independent manual-release devices for operation of lids.

F. Safety Railing System: Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide the following:
      a. Bilco Company (The); Bil-Guard Type S BG-RL2-S Guard.

G. Ladder: Ladder manufacturer’s heavy duty system including aluminum tubular rails, serrated rungs, wall brackets, floor brackets, security doors and extendable safety posts.
   1. Basis-of-Design Products: Subject to compliance with requirements, provide the following:

a. O'Keeffe's Inc.; Heavy Duty Tubular Rail Fixed Access Aluminum Ladder Model 501.
b. O'Keeffe's Inc.; Security Door for Heavy Duty Tubular Rail.
c. O'Keeffe's Inc.; Safety Post.

2.3 Portable Crane

A. Basis-of-Design Product: Thern First Mate – Portable Davit Crane.

B. Winch: Manual
1. Configuration: M2

C. Base: Pedestal 5BP5S
1. Material: 304 Stainless Steel.
2. Provide one base per roof hatch location.

D. Wire Rope Assembly: WS25-28NS
1. Length: 28ft length.
2. Diameter: ¼" inch.
3. Material: Stainless Steel Wire Rope.

2.4 METAL MATERIALS

A. Aluminum sheet: ASTM B209, mill finished.

B. Aluminum Extrusions and Tubes: ASTM B221, manufacturer's standard alloy and temper for type of use, finished to match assembly where used; otherwise mill finished.

C. Stainless Steel Sheet and Shapes: ASTM A240/A240M or ASTM A666, Type 304.

2.5 MISCELLANEOUS MATERIALS

A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Polyisocyanurate Board Insulation: ASTM C1289, thickness and thermal resistivity as indicated.

C. Underlayment:
1. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

D. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:

E. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.

F. Elastomeric Sealant: ASTM C920, elastomeric polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.

G. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify dimensions of roof openings for roof accessories. Install roof accessories according to manufacturer's written instructions.
   1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
   2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
   3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
   4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
   1. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.

C. Seal joints with elastomeric or butyl sealant as required by roof accessory manufacturer.

3.2 REPAIR AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A780/A780M.

B. Clean exposed surfaces according to manufacturer's written instructions.

C. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Penetration firestopping systems for the following applications:
a. Penetrations in fire-resistance-rated walls.
b. Penetrations in horizontal assemblies.
c. Penetrations in smoke barriers.

B. Related Sections:
1. Section 078443 "Joint Firestopping" for joints in or between fire-resistance-rated construction and in smoke barriers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Include product compatibility statement for all products or materials in contact with firestopping system and not listed as being part of firestopping system.

B. 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.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.4 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm experienced in installing penetration firestopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

1.6 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. 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 Approval in its "Approval Guide."

2.2 PENETRATION FIRESTOPPING SYSTEMS

A. Penetration Firestopping Systems: Systems that 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. 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. Hilti, Inc.
b. RectorSeal Corporation.
c. Specified Technologies, Inc.

B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E814 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.

C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E814 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.
      a. Floor penetrations contained and located within the cavity of a wall.
      b. Floor penetrations by floor drains, tub drains or shower drains contained and located within the concealed space of a horizontal assembly.

D. 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.

E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E84.

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.

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 using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

A. General: Install 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. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 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.

END OF SECTION

SECTION 078443 - JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Joints in or between fire-resistance-rated constructions.
2. Joints in smoke barriers.
3. Joints at exterior curtain-wall/floor intersections.

B. Related Sections:
1. Section 078413 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers.
2. Engineering Judgement for curtain wall/floor intersection firestopping.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Include product compatibility statement for all products or materials in contact with firestopping system and not listed as being part of firestopping system.

B. 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.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each joint firestopping system, for tests performed by a qualified testing agency.

1.4 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm experienced in installing joint firestopping systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having

the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its joint firestopping system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

1.6 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 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. Hilti, Inc.
2. RectorSeal Corporation.
3. Specified Technologies, Inc.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:
1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:
a. Joint firestopping systems shall bear classification marking of a qualified testing agency.
1) UL in its "Fire Resistance Directory."
2) Intertek Group in its "Directory of Listed Building Products."

2.3 JOINT FIRESTOPPING SYSTEMS

A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E1966 or UL 2079.
1. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.

C. Joints in Smoke Barriers: Provide joint firestopping 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.

D. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E84.

A. Joints at Exterior Curtain-Wall/Floor Intersections: Provide joint firestopping systems with rating determined in accordance with ASTM E2307.
   1. F-Rating: Equal to or exceeding the fire-resistance rating of the floor assembly.

B. Accessories: Provide components of joint firestopping 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 INSTALLATION

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. General: Install joint firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

C. 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.

D. Install elastomeric fill materials for joint firestopping 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.

3.2 IDENTIFICATION

A. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
   1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
   2. Contractor's name, address, and phone number.
   3. Designation of applicable testing agency.
   4. Date of installation.
   5. Manufacturer's name.
   6. Installer's name.

3.3 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 joint firestopping systems immediately and install new materials to produce joint firestopping systems complying with specified requirements.

END OF SECTION

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Sealant and backing materials.
2. Acoustical sealants.

B. Related Sections:
1. Section 078413 “Penetration Firestopping” for sealants at rated assemblies.

1.2 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

B. Sustainable Design Submittals:
1. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

C. 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.

D. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants for the following joints:
1. Sanded sealant joints.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each kind of joint sealant.

B. 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.

C. Sample Warranties: For special warranties.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C1021 to conduct the testing indicated.

1.5 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. Adhesion Testing: Use ASTM C794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
   2. Compatibility Testing: Use ASTM C1087 to determine sealant compatibility when in contact with glazing and gasket 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.

1.6 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.

1.7 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period:
      a. Silicone Sealants: 20 years from date of Substantial Completion.
      b. All Other Sealants: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sustainable Design Performance Requirements:
1. Sealants shall comply with the following:
a. Low-Emitting Materials: For field-applied sealants that are inside the weatherproofing system, testing and product requirements of the California Department of Health Services CDPH Standard Method v1.1, using CA Section 01350, Appendix B, New Single-Family Residence Scenario.

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. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.

C. Nonstaining Joint Sealants: Where sealants are indicated to be nonstaining, provide products that exhibit no staining of substrates when tested according to ASTM C1248.

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 the following public health and safety requirements:
1. Sealant is certified for compliance with NSF standards for end-use application indicated.
2. Washed and cured sealant complies with the FDA's regulations for use in areas that come in contact with food.

E. Mildew-Resistant Joint Sealants: Where sealants are indicated to be mildew-resistant, provide products formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

F. Colors of Exposed Joint Sealants: Selected to match fixture or as selected by Architect or Landscape Architect from manufacturer's full range.

2.3 JOINT SEALANTS

A. Silicone: Single-component, nonsag, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.
1. Joint Locations: Exterior joints in vertical surfaces and horizontal nontraffic surfaces, and as follows:
a. Construction joints in cast-in-place concrete.

b. Joints between metal panels.
c. Joints between different materials listed above.
d. Perimeter joints between materials listed above and frames of doors, windows, and louvers.
e. Other joints as indicated on Drawings.

2. Basis-of-Design Product: The Dow Chemical Company; DowSil 790, 791, or 795 at Contractor's option.
   a. Subject to compliance with requirements, manufacturers offering comparable products that may be incorporated into the Work include, but are not limited to, the following:
      1) GE Construction Sealants; Momentive Performance Materials Inc.
      2) Pecora Corporation.
      3) Sika Corporation; Joint Sealants.
      4) Tremco Incorporated.

B. Silicone: Single-component, nonsag, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.
   1. Joint Locations: Sealant joints in contact with weather barrier, weather barrier flashing materials, and as follows:
      a. Perimeter joints between materials listed above and frames of doors, windows, and louvers.
   2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
      a. The Dow Chemical Company; DowSil 758 Silicone Weather Barrier Sealant.
      b. Pecora Corporation; AVB Silicone.

C. Silicone: Mildew-resistant, single-component, nonsag, acid-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.
   1. Joint Locations: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces, and as follows:
      a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
      b. Tile control and expansion joints in wet locations.
      c. Other joints as indicated on Drawings.
   2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
      a. GE Construction Sealants; Momentive Performance Materials Inc.; SCS1700 Sanitary.
      b. The Dow Chemical Company; DowSil 786.

D. Urethane: Multicomponent, pourable, urethane joint sealant; ASTM C920, Type M, Grade P, Class 25, Uses T and NT.
   1. Joint Locations: Exterior joints in horizontal traffic surfaces, and as follows:
      a. Isolation and contraction joints in cast-in-place concrete slabs.
      b. Tile control and expansion joints.
      c. Joints between different materials listed above.
      d. Other joints as indicated on Drawings.
   2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
      a. BASF Corporation; MasterSeal SL 2.
      b. Sika Corporation; Joint Sealants; Sikaflex 2c SL.
      c. Tremco Incorporated; THC 900/901.

E. Urethane: Multicomponent, nonsag, urethane joint sealant; ASTM C920, Type M, Grade NS, Class 25, Uses T and NT.
   1. Joint Locations: Interior joints in horizontal traffic surfaces, and as follows:
      a. Isolation joints in cast-in-place concrete slabs.
      b. Control and expansion joints in tile flooring.
      c. Other joints as indicated on Drawings.
   2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
      a. BASF Corporation; MasterSeal NP 2.
      b. LymTal International Inc; Iso-Flex 881 or Iso-Flex 885 SG.
      c. Pecora Corporation; Dynatred.
      d. Sika Corporation; Joint Sealants; Sikaflex 2c NS TG.

F. Urethane: Multicomponent urethane joint sealant; ASTM C920, Type M, Class 25 or greater; Grade NS for sloping and vertical applications and Grade P for deck applications; Use NT. Compatible with asphalt-base waterproofing materials and as recommended by manufacturer for substrate and joint conditions.
   1. Joint Locations: Perimeter of waterproofing and roofing, and roofing accessories.

G. Urethane: Single-component, nonsag, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.
   1. Joint Locations: Interior joints in vertical surfaces and horizontal nontraffic surfaces, and as follows:
      a. Control and expansion joints on exposed interior surfaces of exterior walls.
      b. Tile control and expansion joints.
      c. Vertical joints on exposed surfaces of concrete walls and partitions.
      d. Other joints as indicated on Drawings.
   2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
      a. Pecora Corporation; Dynatrol I-XL.
      b. Polymeric Systems, Inc; Flexiprene 1000.
      c. Sika Corporation; Joint Sealants; Sikaflex Textured Sealant.
      d. Tremco Incorporated; Dymonic.

H. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.
   1. Joint Locations: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement, and as follows:
      a. Control joints on exposed interior surfaces of exterior walls.
      b. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.
      c. Other joints as indicated on Drawings.
   2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
      a. BASF Corporation; MasterSeal NP 520.
      b. Bostik, Inc.; Bosti-Flex Plus.
      c. Pecora Corporation; AC-20.
      d. Tremco Incorporated; Tremflex 834.

I. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 or aromatic polyurea with a Type A shore durometer hardness range of 90 to 95 in accordance with ASTM D2240.

1. Joint Locations: Interior, exposed sawcuts and non-moving control joints in concrete slabs.
2. Color: As selected by architect from standard colors.
3. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
   a. BASF Corporation; MasterSeal CR 190.
   b. Sika Corporation; Joint Sealants; Sikadur 51.

2.4 ACOUSTICAL JOINT SEALANTS

A. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C834. Sealant effectively reduces airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies according to ASTM E90.
   1. Joint Location:
      a. Acoustical joints where indicated.
      b. Other joints as indicated.
   2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
      a. Accumetric LLC; BOSS 826 Acoustical Sound Sealant.
      b. GE Construction Sealants; Momentive Performance Materials Inc.; RCS20 Acoustical.
      c. Grabber Construction Products; Acoustical Sealant GSC.
      d. Hilti, Inc.; CP 506 Smoke and Acoustical Sealant.
      e. Pecora Corporation; AC-20 FTR or AIS-919.
      f. Specified Technologies, Inc.; Smoke N Sound Acoustical Sealant.
      g. Tremco Incorporated; Tremco Acoustical Sealant.
      h. USG Corporation; SHEETROCK Acoustical Sealant.

2.5 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 C1330, Type C (closed-cell material with a surface skin), unless otherwise recommended 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.

2.6 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.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 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 laitance and form-release agents from concrete.
   2. 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.

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.

3.2 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 C1193 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 C1193 unless otherwise indicated.

G. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C919, ASTM C1193, and manufacturer's written recommendations for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.

3.3 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.

END OF SECTION

SECTION 079513.13 - INTERIOR EXPANSION JOINT COVER ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Floor expansion joint covers.
   a. With fire barrier.
2. Wall expansion joint covers.
3. Ceiling expansion joint covers.

B. Related Sections:

1. Section 077129 "Manufactured Roof Expansion Joints" for factory-fabricated roof expansion joint cover assemblies.
2. Section 079513.16 “Exterior Expansion Joint Cover Assemblies.”

1.2 ACTION SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for expansion joint cover assemblies.

1. Floor expansion joint covers.
2. Wall expansion joint covers.
3. Ceiling expansion joint covers.

B. 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 Initial Selection: For each type of exposed finish.

1. Include manufacturer's color charts showing the full range of colors and finishes available for each exposed metal and elastomeric-seal material.

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.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each fire-resistance-rated expansion joint cover assembly, for tests performed by a qualified testing agency.

1.4 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
   1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
   2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 QUALITY ASSURANCE:

A. Manufacturer: Furnish assemblies from one manufacturer with a minimum of five years experience in the design and fabrication of expansion joint cover assemblies.

B. Installer: Firm with a minimum of five years experience in installation of systems similar to those required by this project and acceptable to manufacturer.

1.6 WARRANTY:

A. Provide manufacturer's standard one-year material and workmanship warranty.

B. Warranties shall begin at Date of Substantial Completion.

PART 2 - PRODCTS

2.1 ASSEMBLY DESCRIPTION

A. Furnish units in longest practicable lengths to minimize field splicing.

B. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion joint cover assemblies.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: Provide expansion joint cover assemblies with fire barriers identical to those of systems tested for fire resistance according to ASTM E1966 by a qualified testing agency.

B. Expansion Joint Design Criteria:

1. Seismic Movement:

a. Minimal Seismic Gap: 8 inches
b. Nominal Joint Width: 12 inches.
c. Minimum Joint Width: 4 inches.
d. Maximum Joint Width: 24 inches.

2.3 FLOOR EXPANSION JOINT COVERS

A. Seismic-Pan Floor Joint Cover: Seismic pan assembly with sloped sides allowing extension of unit above floor plane during joint contraction, and equipped with springs to return unit back into alignment during joint expansion. Provide manufacturer's recommended sealant at pan edge.

1. Provide the basis of design product or approved equivalent:
   a. MM Systems, PDSE-1200-50-2.25H with PF-2018F-SC-12-12M 1 hour rated fire barrier below, continuous for run of expansion joint.
      1) Pyro-Flex: PF-2018F-SC-12-12M at floor level where no cover installed at 1-hour rated barrier
2. Application: Floor to wall.
3. Installation: Recessed.
4. Load Capacity: 100 pounds per square foot minimum.
5. Fire-Resistance Rating: Not less than that of adjacent construction.
6. Pan Recess Depth: 1 inch.
7. Accessories: Fasteners and retainer bar.

2.4 WALL EXPANSION JOINT COVERS

A. Glide-Plate Wall Joint Cover: Assembly consisting of center plate that slides in and out of slots in metal frames fixed to sides of joint gap.

1. Provide the basis of design product or approved equivalent:
   a. MM Systems, SWC-1200.
2. Application: Wall to corner.
3. Fire-Resistance Rating: Not less than that of adjacent construction.
4. Exposed Metal: Prefinished aluminum:
   a. Pretreatment: Provide factory applied seven-step chromate conversion coating for application of field-applied paints.
   b. Fluoropolymer coating system: Super-cote I.
   c. Two-coat, shop-applied, baked-on 70% fluoropolymer coating system based on Elf Atochem, Inc., Kynar 500 or Ausimont U.S.A., Inc., Hylar 5000 resin

(polyvinylidene fluoride, PVDF), formulated by a licensed manufacturer and applied by manufacturer's approved applicator, to meet AAMA 605.2-90.

d. Coating system shall provide minimum 1.2 mil dry film thickness consisting of 0.2 to 0.4 mil primer and minimum 1.0 mil color coat, baked on at 450 degrees F. metal temperature.

e. Color: Custom color as selected by Architect.

2.5 CEILING EXPANSION JOINT COVERS

A. Glide-Plate Ceiling Joint Cover: Assembly consisting of center plate that slides in and out of slots in metal frames fixed to sides of joint gap.

1. Provide the basis of design product or approved equivalent:
   a. MM Systems, SWC-1200.
2. Application: Wall to ceiling.
3. Fire-Resistance Rating: Not less than that of adjacent construction.
4. Exposed Metal: Prefinished aluminum:
   a. Pretreatment: Provide factory applied seven-step chromate conversion coating for application of field-applied paints.
   b. Fluoropolymer coating system: Super-cote I.
   c. Two-coat, shop-applied, baked-on 70% fluoropolymer coating system based on Elf Atochem, Inc., Kynar 500 or Ausimont U.S.A., Inc., Hylar 5000 resin (polyvinylidene fluoride, PVDF), formulated by a licensed manufacturer and applied by manufacturer's approved applicator, to meet AAMA 605.2-90.
   d. Coating system shall provide minimum 1.2 mil dry film thickness consisting of 0.2 to 0.4 mil primer and minimum 1.0 mil color coat, baked on at 450 degrees F. metal temperature.
   e. Color: Custom color as selected by Architect.

2.6 MATERIALS

A. Aluminum: ASTM B221 (ASTM B221M), Alloy 6063-T5 for extrusions; ASTM B209 (ASTM B209M), 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 A240/A240M or ASTM A666, Type 304 for plates, sheet, and strips.

C. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint and to comply with performance criteria for required fire-resistance rating.

D. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.7 ALUMINUM FINISHES

A. Mill finish, factory primed.

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 INSPECTION

A. Prior to installation of cover assemblies, coordinate inspection of fire barrier by Project Inspector.

3.4 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. Repair or grout block out as required for continuous frame support using nonmetallic, shrinkage-resistant grout.
2. Install frames in continuous contact with adjacent surfaces.

a. Shim only as approved by manufacturer.

3. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
4. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation.
5. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
6. Locate anchors at interval recommended by manufacturer, but not less than 3 inches (75 mm) from each end and not more than 24 inches (600 mm) o.c.

C. Install with hairline mitered corners where expansion joint cover assemblies change direction or abut other materials.

D. Terminate exposed ends of expansion joint cover assemblies with field- or factory-fabricated termination devices.

E. 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.

3.5 PROTECTION

A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.

B. Protect the installation from damage by work of other Sections. Where necessary due to heavy construction traffic, remove and properly store cover plates or seals and install temporary protection over expansion joint cover assemblies. Reinstall cover plates or seals prior to Substantial Completion.

END OF SECTION 079513.13

SECTION 079513.16 - EXTERIOR EXPANSION JOINT COVER ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior expansion joint covers for walls and soffits.
   a. With thermal vapor barrier.

B. Related Requirements:

1. Section 077129 "Manufactured Roof Expansion Joints" for factory-fabricated roof expansion joint cover assemblies.
2. Section 079513.13 “Interior Expansion Joint Cover Assemblies” for interior factory fabricated interior floor, wall and ceiling expansion joint covers and fire barrier.

1.2 ACTION SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for expansion joint cover assemblies.

1. Exterior expansion joint covers.

B. 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 Initial Selection: For each type of exposed finish.

1. Include manufacturer's color charts showing the full range of colors and finishes available for each exposed metal and elastomeric seal material.

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.

1.3 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
   1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
   2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.4 QUALITY ASSURANCE:

A. Manufacturer: Furnish assemblies from one manufacturer with a minimum of five years experience in the design and fabrication of expansion joint cover assemblies.

B. Installer: Firm with a minimum of five years experience in installation of systems similar to those required by this project and acceptable to manufacturer.

1.5 WARRANTY:

A. Provide manufacturer's standard one-year material and workmanship warranty.

B. Warranties shall begin at Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Furnish units in longest practicable lengths to minimize field splicing.

B. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion joint cover assemblies.

2.2 PERFORMANCE REQUIREMENTS

A. Expansion Joint Design Criteria:

   1. Seismic Movement:

      a. Seismic Gap: 8 inches.
      b. Nominal Joint Width: 12 inches.
      c. Minimum Joint Width: 4 inches.
      d. Maximum Joint Width: 24 inches.

2.3 EXTERIOR EXPANSION JOINT COVERS

A. Exterior Metal-Plate Joint Cover: Assembly consisting of sliding metal cover plate in continuous contact with gaskets mounted on metal frames fixed to sides of joint gap.

1. Provide the basis of design product or approved equivalent:
   a. MM Systems , VSS-1221-E continuous for run of expansion joint.
      1) With IVB-1200-R25 insulating vapor barrier
         a) Minimum insulating value: R-25.
2. Application: Wall to wall.
3. Installation: Recessed back into expansion joint.
4. Pantograph: Stainless steel, spaced as necessary to comply with wind load conditions.
5. Weather seal: Continuous elastomeric sheet.
6. Color: Black.

2.4 MATERIALS

A. Aluminum: ASTM B221 (ASTM B221M), Alloy 6063-T5 for extrusions; ASTM B209 (ASTM B209M), 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.

2.5 ACCESSORIES

A. Manufacturer's stainless steel attachment devices. Include anchors, clips, fasteners, set screws, spacers, sealants, adhesives and other accessories compatible with material in contact, as indicated or required for complete installations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces where expansion joint cover assemblies will be installed for installation tolerances and other conditions affecting performance of the Work.

B. Notify Architect where discrepancies occur that will affect proper expansion joint cover assembly installation and performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to expansion joint cover assembly manufacturer's written instructions.

B. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion joint cover assemblies. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of expansion joint cover assemblies.

3.3 INSTALLATION

A. Comply with manufacturer's written instructions for storing, handling, and installing expansion joint cover assemblies and materials unless more stringent requirements are indicated.

B. Prior to installation of cover, coordinate inspection of vapor barrier by Project Inspector.

C. 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. Shim only as allowed by manufacturer in writing.

5. Locate anchors at interval recommended by manufacturer, but not less than 3 inches (75 mm) from each end and not more than 24 inches (600 mm) o.c.

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.

3.4 CONNECTIONS

A. Transition to Roof Expansion Joint Covers: Coordinate installation of exterior wall and soffit expansion joint covers with roof expansion joint covers specified in Section 077129 "Manufactured Roof Expansion Joints." Install factory-fabricated units or custom flashings at transition between exterior walls and soffits and roof expansion joint cover assemblies.

3.5 PROTECTION

A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.

B. Protect the installation from damage by work of other Sections.

END OF SECTION 079513.16

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
1. Hollow metal doors and frames.

B. Related Sections:
1. Section 099100 "Painting and Coating" for painted finish for hollow metal doors and frames.

1.2 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to ANSI/SDI A250.8.

1.3 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

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 electrical raceway and preparation for electrified hardware, access control systems, and security systems.
6. Details of anchorages, joints, and connections.

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.

1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of fire-rated hollow-metal door and frame assembly for tests performed by a qualified testing agency indicating compliance with performance requirements.

1.6 CLOSEOUT SUBMITTALS

A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure according to NFPA 252 or UL 10C.
   1. Smoke- and Draft-Control Door Assemblies: 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.

2.2 INTERIOR DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B. At locations indicated in the Door and Frame Schedule.
   1. Doors:
      a. Type: As indicated in the Door and Frame Schedule.
      b. Thickness: 1-3/4 inches.
      c. Face: Uncoated steel sheet, minimum thickness of 0.042 inch.
      d. Edge Construction: Model 2, Seamless.
      e. Core: Manufacturer's standard.
      f. Fire-Rated Core: Manufacturer's standard core for fire-rated doors.
   2. Frames:
      a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch.
      b. Construction: Knocked down.
   3. Factory Finish: Prime.
   4. Site Finish: Paint.
      a. Color: Refer to finish schedule for color.
      b. Paint system: Refer to Section 099100 “Painting and Coating” for painted finish for hollow metal doors and frames.

2.3 EXTERIOR DOORS AND FRAMES

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
   1. Ceco Door;
   2. ASSA ABLOY;
   3. Or equal.

B. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

C. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B. At locations indicated in the Door and Frame Schedule.
   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 0.042 inch, with minimum A60 coating.
      d. Edge Construction: Model 2, Seamless.
      e. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
      f. Bottom Edges: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
      g. Core: Polystyrene .
      h. Fire-Rated Core: Manufacturer's standard core for fire-rated doors.
   2. Frames:
      a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A60 coating.
      b. Provide with flange on exterior side of frame to transition between weather barrier and frame.
      c. Construction: Face welded.
   3. Factory Finish: Prime.
   4. Site Finish: Paint.
      a. Color: To match architect’s sample [UC106685F Duranar Sunstorm Silverstorm (PPG)].
      b. Paint system: Refer to Section 099100 “Painting and Coating” for painted finish for hollow metal doors and frames.

2.4 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 A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized according to ASTM A153/A153M, Class B.

2.5 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.

C. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.

D. 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.

E. Sound-Deadening Insulation: ASTM C665, 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 E136 for combustion characteristics.

F. Glazing: Comply with requirements in Section 088000 "Glazing."

2.6 FABRICATION

A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

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. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
2. 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 ANSI/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 butted or 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.

2.7 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 ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 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. Touch up factory-applied finishes where spreaders are removed.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

A. Hollow-Metal Frames: Comply with ANSI/SDI A250.11.
   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. Sound Deadening: Solidly pack mineral-fiber insulation inside frames.
   5. 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.

B. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
   1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8.
   2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
   3. Smoke-Control Doors: Install doors according to NFPA 105.

C. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.3 REPAIR

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

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Solid-core seven-ply flush wood veneer-faced doors for transparent finish at locations as indicated on Drawings.
2. Solid-core flush wood doors with plastic-laminate-faces at locations as indicated on Drawings.
3. Hollow-core flush wood doors with hardboard or MDF faces at locations as indicated on Drawings.
4. Wood door frames at locations as indicated on Drawings.
5. Factory priming flush wood doors.
6. Factory fitting flush wood doors to frames and factory machining for hardware.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:
1. Door core materials and construction.
2. Door edge construction
3. Door face type and characteristics.
4. Factory-machining criteria.
5. Factory-priming specifications.

B. Sustainable Design Submittals:
1. Laboratory Test Reports: For composite wood products, indicating compliance with requirements for low-emitting materials.
2. Sustainably Forestry chain of custody documentation.

C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:
1. Door schedule indicating door location, type, size, fire protection rating, and swing.
2. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
3. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
4. Dimensions and locations of blocking for hardware attachment.
5. Clearances and undercuts.
6. Doors to be factory primed and application requirements.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Wood Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated on Drawings, based on testing at positive pressure in accordance with UL 10C or NFPA 252.

B. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.

C. 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.

D. Sustainable Design Performance Requirements:
1. Low-Emitting Materials: Composite wood products shall made using ultra-low-emitting formaldehyde resins as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde.
2. Sustainable Forestry: Wood cores shall be made from wood sourced from sustainably managed forests. FSC preferred, SFI acceptable when FSC products are not available.

2.2 FLUSH WOOD DOORS, GENERAL

A. Quality Standard: In addition to requirements specified, comply with AWI/AWMAC/WI's "Architectural Woodwork Standards."

B. ANSI/WDMA I.S. 1A Performance Grade:
1. Standard Duty: Unless otherwise indicated on Drawings.

C. Fire-Protection-Rated Doors:
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, unless otherwise required. Comply with specified requirements for exposed vertical edges.
3. Pairs of Doors: 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.

D. Hollow-Core Doors:
1. Construction: Standard hollow core.

2.3 SOLID-CORE SEVEN-PLY FLUSH WOOD VENEER-FACED DOORS FOR TRANSPARENT FINISH

A. Exterior-grade Doors for interior use, Seven-Ply Veneer-Faced

B. Performance Grade: ANSI/WDMA I.S. 1A Extra Heavy Duty

C. ANSI/WDMA I.S. 1A Quality Grade: Custom

D. Wood Veneer Faces:
1. Species: Select White Maple
2. Color: Clear, CL18 (Basis of Design VT Industries)

E. Exposed Vertical and Top Edges: Same species as faces or a compatible species - Architectural Woodwork Standards edge Type A.

F. Core:
1. Either glued wood stave or WDMA I.S. 10 structural composite lumber.
   a. Provide FSC Mix cores.
      1) SFI also acceptable when FSC is not available.
2. Adhesives: Type I (exterior) in accordance with WDMA T.M. 6.
3. Core for fire-rated doors, as required to achieve fire-protection rating indicated on Drawings.
   a. Blocking for Mineral-Core Doors: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated on Drawings as [needed to eliminate through-bolting hardware.

G. Room Match:
1. Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by 10 feet or more.

H. Frames: Steel frames, refer to Section 081113 “Hollow Metal Doors And Frames.”

2.4 SOLID-CORE FLUSH WOOD DOORS WITH PLASTIC-LAMINATE-FACES

A. Located at group restrooms

B. Refer to SOLID CORE SEVEN PLY FLUSH WOOD VENEER-FACED DOORS with differences as follows:

C. Plastic-Laminate Faces: Through-color high-pressure decorative laminates complying with ISO 4586-3, Grade HGS.
1. Colors, Patterns, and Finishes: As selected by Architect from laminate manufacturer's full range of products.
2. Adhesive with maximum resistance to moisture/humidity exposure.
   a. Provide basis of design or approved equal: Resorcinol.

D. Vertical, Bottom and Top Edges: Plastic laminate that matches faces, applied before faces.

1. Fire-Rated Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed vertical edges.

E. Mineral-Core Doors: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

F. Frames: Galvanized steel frames, refer to Section 081113 “Hollow Metal Doors And Frames.”

2.5 FLUSH WOOD DOORS FOR OPAQUE FINISH

A. Interior Hollow-Core Doors:
1. Grade: Premium.
2. Faces: Hardboard or MDF.
   a. Hardboard Faces: ANSI A135.4, Class 1 (tempered) or Class 2 (standard).
   b. MDF Faces: ANSI A208.2, Grade 150 or Grade 160.

2.6 WOOD DOOR FRAMES

A. Architectural Woodwork Standards Grade: Custom.

B. Wood Species: Eastern white pine, sugar pine, or western white pine.

C. Finish: Painted.

2.7 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated.
1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

B. Factory machine doors for hardware that is not surface applied.

C. Openings: Factory cut and trim openings through doors.
1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."

2.8 FACTORY PRIMING

A. Doors for Opaque Finish: Factory prime faces, all four edges, edges of cutouts, and mortises with one coat of wood primer specified in Section 099100 " Painting."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Hardware: For installation, see Section 087100 "Door Hardware."

B. Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
   1. Install fire-rated doors in corresponding fire-rated frames in accordance with NFPA 80.
   2. Install smoke- and draft-control doors in accordance with NFPA 105.

C. Job-Fitted Doors:
   1. Align and fit doors in frames with uniform clearances and bevels as indicated below.
      a. Do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors.
   2. Machine doors for hardware.
   3. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
   4. Clearances:
      a. Provide 1/8 inch at heads, jambs, and between pairs of doors.
      b. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated on Drawings.
      c. Where threshold is shown or scheduled, provide1/4 inch from bottom of door to top of threshold unless otherwise indicated.
      d. Comply with NFPA 80 for fire-rated doors.

D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

END OF SECTION

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Access doors and frames for walls and ceilings.

1.2 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. Product Schedule: For access doors and frames. Use same designations indicated on Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, according to NFPA 252 or UL 10B.

2.2 ACCESS DOORS AND FRAMES

A. Frameless Flush Access Doors with Taped Concealed Flanges:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Acudor Products, Inc.
b. Babcock-Davis.
c. Karp Associates, Inc.
d. Milcor; Commercial Products Group of Hart & Cooley, Inc.
e. Nystrom.
f. Williams Bros. Corporation of America (The).
2. Description: Face of door flush with frame; with concealed flange for gypsum board installation and concealed hinge.
3. Uncoated Steel Sheet for Door: Nominal 0.060 inch, 16 gage, factory primed.
4. Frame Material: Same material and thickness as door.
5. Latch and Lock: Cam latch, screwdriver operated.

2.3 FIRE-RATED ACCESS DOORS AND FRAMES

A. Fire-Rated, Flush Access Doors with Concealed Flanges:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Acudor Products, Inc.
b. Babcock-Davis.
c. Karp Associates, Inc.
d. Nystrom.
e. Williams Bros. Corporation of America (The).
2. Description: Door face flush with frame, with concealed flange for gypsum board installation, self-closing door, and concealed hinge.
3. Fire-Resistance Rating: Not less than that of adjacent construction.
4. Uncoated Steel Sheet for Door: Nominal 0.036 inch, 20 gage, factory primed.
5. Frame Material: Same material, thickness, and finish as door.
6. Latch and Lock: Self-closing, self-latching door hardware, operated by key.

2.4 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.

C. Frame Anchors: Same material as door face.

D. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

2.5 FABRICATION

A. 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.

B. 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.

C. Latch and Lock Hardware:
1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.

2.6 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
   1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

B. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION

SECTION 083323 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Insulated service doors.

B. Related Sections:
1. Section 055000 "Metal Fabrications" for miscellaneous steel supports.

1.2 ACTION SUBMITTALS

A. Product Data: For each type and size of overhead coiling door and accessory.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
1. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
2. Show locations of controls, locking devices and other accessories.
3. Include diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of doors that fail in materials or workmanship within specified warranty period.
1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and California Building Code, Chapter 11.

B. Structural Performance, Exterior Doors: Capable of withstanding the following design wind loads:
   1. Design Wind Load: As indicated on Drawings.
   2. Testing: According to ASTM E330/E330M.

C. Seismic Performance: Overhead coiling doors shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.2 DOOR ASSEMBLY

A. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. C.H.I. Overhead Doors, Inc.
      b. Clopay Building Products.
      c. Cookson Company.
      d. Cornell.
      e. McKeon Rolling Steel Door Company, Inc.
      f. Overhead Door Corporation.

B. Operation Cycles: Door components and operators capable of operating for not less than 20,000 cycles.

C. Door Curtain Material: Galvanized steel.

D. Door Curtain Slats: Flat profile slats.
   1. Insulated-Slat Interior Facing: Metal.

E. 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.

F. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.

G. Hood: Match curtain material and finish .
   1. Mounting: As indicated on Drawings.

H. Locking Devices: Equip door with locking device assembly.
   1. Locking Device Assembly: Cremone-type, both jamb sides locking bars.

I. Curtain Accessories: Equip door with weatherseals and push/pull handles.

J. Door Finish:

1. Baked-Enamel or Powder-Coated Finish: Color matching Architect's sample [UC106685F Duranar Sunstorm Silverstorm (PPG)].
2. Interior Curtain-Slat Facing: Selected from Manufacturer's standard color range.

2.3 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. 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 E84 or UL 723. Enclose insulation completely within slat faces.
   2. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face, with minimum steel thickness of 0.010 inch.

B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

2.4 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.

2.5 LOCKING DEVICES

A. 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".

2.6 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.

B. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.

2.7 COUNTERBALANCE 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. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.8 MANUAL DOOR OPERATORS

A. General: Equip door with manual door operator by door manufacturer.

B. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum 25-lbf force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.

PART 3 - EXECUTION

3.1 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.

3.2 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION

SECTION 083518 - MULTIPANEL BIFOLD ALUMINUM-FRAMED GLASS DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Multipanel bifold aluminum-framed glass doors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:
1. Include plans, elevations, sections, and installation details.
2. Indicate dimensions, configuration of panels, and stacking layout.

C. Samples: For each multipanel bifold aluminum-framed glass door and for each color specified.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each multipanel bifold aluminum-framed glass door, for tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency; and for each class and performance grade indicated, tested at AAMA gateway size.

B. Sample Warranty: For manufacturer's special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For multipanel bifold aluminum-framed glass doors to include in maintenance manuals. Include finishes, weather stripping, operable panels, and operating hardware.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An installer acceptable to multipanel bifold aluminum-framed glass door manufacturer for installation of units required for this Project.

1.6 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace multipanel bifold aluminum-framed glass doors that fail(s) 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 excess deflection.
      c. Faulty operation of movable panels and hardware.
      d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
      e. Failure of insulating glass.
   2. Warranty Period:
      a. Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Arcadia, Inc.
2. Nana Wall Systems, Inc.

2.2 PERFORMANCE REQUIREMENTS

A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

1. Product Certification: AAMA certified with label attached to each door.

B. Thermal Transmittance: NFRC 100 maximum total fenestration product U-factor of 0.32 Btu/sq. ft. x h x deg F.

C. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum total fenestration product SHGC of 0.28.

D. Thermal Movements: Provide multipanel bifold aluminum-framed glass doors, 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.

2.3 MULTIPANEL BIFOLD ALUMINUM-FRAMED GLASS DOORS

A. Multipanel Bifold Aluminum-Framed Glass Doors: Provide extruded-aluminum-framed multipanel bifold glass doors, complete with glazing, threshold, flashings, support, and anchorage devices.

1. Application: Multiple panel, slide to one side.

B. Frames and Door Panels: Fabricated from aluminum extrusions complying with AAMA/WDMA/CSA 101/I.S.2/A440. Provide factory-assembled door panels that are reglazable without dismantling panel framing, and factory-assembled or field-assembled frames.

1. Thermally Improved 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. Door Panel Design: Narrow stile design.

2.4 GLAZING

A. Glass and Glazing: Manufacturer's standard glazing system that produces weathertight seal. Comply with requirements indicated in Section 088000 "Glazing".

2.5 HARDWARE

A. Provide manufacturer's standard hardware, fabricated from a corrosion-resistant material compatible with door panels and other components, and complying with AAMA 907. Provide hardware designed to smoothly operate, tightly close, and securely lock multipanel bifold aluminum-framed glass doors. Size hardware to accommodate panel weights and dimensions. Provide full-perimeter weatherstripping for each door panel.

B. Panel Support System: Provide panel support system designed for size, weight, and performance requirements of multipanel bifold aluminum-framed glass doors indicated. Provide carriers with sealed ball bearings.

1. Overhead Supported: Provide multiwheeled overhead carriers suspended from steel or aluminum track, with lower guide system engaged in threshold for smooth operation. Limit track deflection to no more than 0.10 inch between supports when fully loaded.
2. Adjustment: Provide panel support system capable of being adjusted for smooth operation and clearances without needing to remove panels from tracks.
3. Threshold Configuration: Extruded-aluminum , thermally broken, threshold with raised, weather-resistant profile with concealed drainage system.
    a. Aluminum Finish: To match panel.

C. Panel Hinges: Stainless-steel, multileaf hinge with painted finish to match exterior. Provide integral hangers and guides for hinges that engage panel support system.

D. Locking System:

1. Primary Entrance Panel: Provide manufacturer's standard keyed multipoint locking device, with lever handles on the interior and exterior that operate dead bolt and concealed top and bottom rods.

2. Trim Design: As selected from manufacturer's full range.
   a. Finish: As selected from manufacturer's full range of finishes.
3. Cylinders: As specified in Section 087100 "Door Hardware."

2.6 ACCESSORIES

A. Trim: Provide interior and exterior casings, jamb extensions, and other components in material and finish to match door frames.

B. 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.

C. Anchors, Clips, and Accessories: Provide anchors, clips, and accessories of aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron for multipanel bifold aluminum-framed glass doors, complying with ASTM B456 or ASTM B633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.

1. Windborne-Debris Resistance: Provide anchors of same design used in windborne-debris resistance testing.

2.7 FABRICATION

A. 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.

B. Factory-Glazed Fabrication: Glaze bifold aluminum-framed glass doors in the factory.

2.8 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.

2.9 ALUMINUM FINISHES

A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.

1. Color: Medium Dark Bronze. (Basis of Design Arcadia AB5).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing multipanel bifold aluminum-framed glass doors, hardware, accessories, and other components.

B. Install multipanel bifold aluminum-framed glass 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 wall flashing, vapor retarders, air barriers, water/weather barriers, and other adjacent construction.

C. Set threshold members in bed of sealant or with gaskets, as indicated, to provide weathertight construction.

D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.2 ADJUSTING

A. Adjust hardware for proper alignment, smooth operation, and proper latching without unnecessary force or excessive clearance.

B. Adjust hardware and operable panels to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Aluminum-framed storefront systems – submitted to Division of the State Architect with calculations.
   a. Interior
   b. Exterior
      1) Vertical fin extrusions
   c. **NOTE:** Any substitutions will require submittal of the storefront taller than 10 feet to Division of the State Architect as a revision and compensation for the time of the Design Team and DSA Reviewers will be paid by the General Contractor.
2. Aluminum-framed entrance door systems

B. Related Sections:
1. Section 085413 "Door Hardware."
2. Section 084123 "Fire-Rated Aluminum Framed Entrances and Storefronts."
3. Section 084413 "Glazed Aluminum Curtain Walls" for spandrel panels and operable windows.
4. Section 088000 "Glazing" for energy performance requirements for glazing.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:
1. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.
1. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
2. Include point-to-point wiring diagrams.

D. Samples: For each type of exposed finish required.

E. Delegated-Design Submittal: For aluminum-framed entrances and storefronts, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Energy Performance Certificates: NFRC-certified energy performance values from manufacturer.

B. Product Test Reports: For aluminum-framed entrances and storefronts.

C. Sample Warranties: For special warranties.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For aluminum-framed entrances and storefronts to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Testing Agency Qualifications: Qualified according to ASTM E699 for testing indicated and acceptable to Owner and Architect.

C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
   1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.6 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. Warranty Period: Five years from date of Substantial Completion.

B. Special Finish Warranty, Anodized Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS FOR EXTERIOR STOREFRONT FOR SUBSTITUTIONS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design aluminum-framed entrances and storefronts.

B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
   1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
   2. Failure also includes the following:
      a. Thermal stresses transferring to building structure.
      b. Glass breakage.
      c. Noise or vibration created by wind and thermal and structural movements.
      d. Loosening or weakening of fasteners, attachments, and other components.
      e. Failure of operating units.

C. Structural Loads:
   1. Wind Loads: As indicated on Drawings.
   2. Other Design Loads: As indicated on Drawings.

D. Deflection of Framing Members: At design wind pressure, as follows:
   1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
   2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch, whichever is smaller.
      a. Operable Units: Provide a minimum 1/16-inch clearance between framing members and operable units.

E. Structural: Test according to ASTM E330/E330M as follows:
   1. When tested at positive and negative wind-load design pressures, storefront assemblies, including entrance doors, do not evidence deflection exceeding specified limits.
   2. When tested at 150 percent of positive and negative wind-load design pressures, storefront assemblies, including entrance doors and 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. Water Penetration under Static Pressure: Test according to ASTM E331 as follows:
   1. No evidence of water penetration through fixed glazing and framing areas, including entrance doors, when tested according to a minimum static-air-

pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. .

G. Seismic Performance: Aluminum-framed entrances and storefronts shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. Seismic Drift Causing Glass Fallout: Complying with AAMA 501.6 criteria for passing based on building occupancy type at design displacement by engineering analysis or by testing.

H. Energy Performance: Certified and labeled by manufacturer for energy performance as follows:
1. Thermal Transmittance (U-factor):
a. Fixed Glazing and Framing Areas: U-factor for the system of not more than 0.41 Btu/sq. ft. x h x deg Fas determined according to NFRC 100.
2. Solar Heat-Gain Coefficient (SHGC):
a. Fixed Glazing and Framing Areas: SHGC for the system of not more than 0.26 as determined according to NFRC 200.
3. Air Leakage:
a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft. when tested according to ASTM E283.
b. Entrance Doors: Air leakage of not more than 1.0 cfm/sq. ft.at a static-air-pressure differential of 1.57 lbf/sq. ft..

I. 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.

J. Sustainable Design Performance Requirements:
1. Interior sealants shall comply with the following:
a. Low-Emitting Materials: Testing and product requirements of the California Department of Health Services CDPH Standard Method v1.1, using CA Section 01350, Appendix B, New Single-Family Residence Scenario.

2.2 EXTERIOR STOREFRONT SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Arcadia, Inc.
2. EFCO Corporation.
3. Kawneer North America, an Arconic company.
4. Oldcastle Building Envelope.
5. Peerless Door & Glass LLC.
6. YKK AP America Inc.

B. Basis of Design – submitted to Division of the State Architect with calculations: Arcadia AFG451T.

C. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Exterior Framing Construction: Thermally broken.
2. Glazing System: Retained mechanically with gaskets on four sides.
3. Finish: Color anodic finish.
4. Fabrication Method: Field-fabricated stick system.
5. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
6. Steel Reinforcement: As required by manufacturer.

D. Vertical Fins: Manufacturer's extruded-aluminum members of thickness required and reinforced as required to support imposed loads.
1. Profile: As indicated.
2. Attachment: Custom bracket as indicated.
3. Finish: Color anodic finish.

E. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

F. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

2.3 INTERIOR STOREFRONT SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Arcadia, Inc.
2. EFCO Corporation.
3. Kawneer North America, an Arconic company.
4. Oldcastle Building Envelope.
5. Peerless Door & Glass LLC.
6. YKK AP America Inc.

B. Basis of Design – submitted to Division of the State Architect with calculations: Arcadia AG451 (non-thermal).

C. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
1. Interior Framing Construction: Nonthermal.
2. Glazing System: Retained mechanically with gaskets on four sides.
3. Finish: Color anodic finish.
4. Fabrication Method: Field-fabricated stick system.
5. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
6. Steel Reinforcement: As required by manufacturer.

D. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

E. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

2.4 ENTRANCE DOOR SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Arcadia, Inc.
2. EFCO Corporation.
3. Kawneer North America, an Arconic company.
4. Oldcastle Building Envelope.
5. Peerless Door & Glass LLC.
6. YKK AP America Inc.

B. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.
1. Door Construction: 2- to 2-1/4-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.
a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.
2. Door Design: Heavy Duty Wide Stile – 5 inch.
3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.
a. Provide nonremovable glazing stops on outside of door.
4. Finish: Match adjacent storefront framing finish.

2.5 ENTRANCE DOOR HARDWARE

A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."

B. Provide seals and sweeps as indicated.

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.

C. Glazing Sealants: As recommended by manufacturer.

2.7 MATERIALS

A. Sheet and Plate: ASTM B209.

B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.

C. Extruded Structural Pipe and Tubes: ASTM B429/B429M.

D. Structural Profiles: ASTM B308/B308M.

E. Steel Reinforcement:
1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.

F. Steel Reinforcement Primer: 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.

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 that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

D. Bituminous Paint: Cold-applied asphalt-mastic paint 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.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

G. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.10 ALUMINUM FINISHES

A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
1. Color: Medium Dark Bronze. (Basis of Design Arcadia AB5).

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Seal perimeter and other joints watertight unless otherwise indicated.

B. Metal Protection:
1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Set continuous sill members and flashing in full sealant bed, as specified in Section 079200 "Joint Sealants," to produce weathertight installation.

D. Install joint filler behind sealant as recommended by sealant manufacturer.

E. Install components plumb and true in alignment with established lines and grades.

F. Install glazing as specified in Section 088000 "Glazing."

G. Install entrance 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.

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Field Quality-Control Testing: Perform the following test on representative areas of aluminum-framed entrances and storefronts. Minimum 5 percent of storefront area, and one entrance door to be tested.
   1. Water Penetration: ASTM E1105 at a minimum uniform static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft., and shall not evidence water penetration.

C. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION

SECTION 084123 – FIRE-RATED ALUMINUM FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Fire rated glazing and framing systems for installation as doors and sidelights in interior openings

B. Related Sections:
   1. Section 078443 "Joint Firestopping:" Firestops between work of this section and other fire resistive assemblies.
   2. Section 087100 "Door Hardware."
   3. Section 088813 "Fire-Rated Glazing."

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. Fire safety related:
      a. ASTM E119: Methods for Fire Tests of Building Construction and Materials.
   2. Material related
      a. ASTM A 1008/A 1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength, Low Alloy, and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2007.
      b. ASTM A 1011/A 1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2006b.

B. American Welding Society (AWS)
   1. AWS D1.3 - Structural Welding Code - Sheet Steel; 2007

C. National Fire Protection Association (NFPA):
   1. NFPA 80: Fire Doors and Windows.
   2. NFPA 252: Fire Tests of Door Assemblies
   3. NFPA 257: Fire Test of Window Assemblies

D. Underwriters Laboratories, Inc. (UL):
   1. UL 9: Fire Tests of Window Assemblies.
   2. UL 10 B: Fire Tests of Door Assemblies
   3. UL 10 C: Positive Pressure Fire Tests of Window & Door Assemblies
   4. UL 263: Fire tests of Building Construction and Materials

E. American National Standards Institute (ANSI):

1. ANSI Z97.1: Standard for Safety Glazing Materials Used in Buildings

F. Consumer Product Safety Commission (CPSC):
1. CPSC 16 CFR 1201: Safety Standard for Architectural Glazing Materials

G. American Society of Civil Engineers (ASCE)
1. ASCE 7 – Minimum Design Loads for Buildings and Other Structures; 2005

1.3 DEFINITIONS

A. Manufacturer: A firm that produces primary glass, fabricated glass or framing as defined in referenced glazing publications.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 SUBMITTALS

A. Product Data:
1. Technical Information: Submit latest edition of manufacturer's product data providing product descriptions, technical data, Underwriters Laboratories, Inc. listings and installation instructions.

B. Shop Drawings:
1. Include plans, elevations and details of product showing component dimensions; framing opening requirements, dimensions, tolerances, and attachment to structure.

C. Samples. For following products:
1. Glass sample-as provided by manufacturer.
2. Sample of frame.
3. Verification of sample of selected finish.

D. Glazing Schedule: Use same designations indicated on drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.

E. Warranties: Submit manufacturer's warranty.

F. Certificates of compliance from glass and glazing materials manufacturers attesting that glass and glazing materials furnished for project comply with requirements.
1. Separate certification will not be required for glazing materials bearing manufacturer's permanent label designating type and thickness of glass, provided labels represent a quality control program involving a recognized certification agency or independent testing laboratory acceptable to authority having jurisdiction

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualifications according toInternational Accreditation Service for a Type A Third-Party Inspection Body (Field Services ICC-ES Third-Party Inspections Standard Operating Procedures, 00-BL-S0400 and S0401).

B. International Accreditation Service for Testing Body-Building Materials and Systems
   1. Fire Testing
      a. ASTM Standards E 119
      b. CPSC Standards 16 CFR 1201
      c. NFPA Standards 252, 257
      d. UL Standards 9, 10B, 10C, 1784, UL Subject 63
      e. BS 476; Part 22: 1987
      f. EN 1634-1

C. Fire-Rated Window Assemblies: Assemblies complying with NFPA 80 that are classified and labeled by UL, for fire ratings indicated, based on testing according to NFPA 257 and UL 9. For 45-minute assemblies only.

D. Fire-Rated Wall Assemblies: Assemblies complying with ASTM E119 that are classified and labeled by UL, for fire ratings indicated, based on testing in accordance with UL 263, ASTM E119.

E. Listings and Labels - Fire Rated Assemblies: Under current follow-up service by Underwriters Laboratories® maintaining a current listing or certification. Label assemblies accordance with limits of manufacturer's listing.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle under provisions specified by manufacturer.

1.8 PROJECT CONDITIONS

A. Obtain field measurements prior to fabrication of frame units. If field measurements will not be available in a timely manner coordinate planned measurements with the work of other sections.

B. Note whether field or planned dimensions were used in the creation of the shop drawings.

C. Coordinate the work of this section with others effected including but not limited to: other interior envelope components and door hardware beyond that provided by this section.

1.9 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to replace units that deteriorate within specified warranty period.

B. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Provide Basis of Design Frame System or approved equivalent: "Fireframes Aluminum Series" fire-rated frame system as manufactured and supplied by Technical Glass Products.

2.2 PERFORMANCE REQUIREMENTS

A. System Description:
   1. Steel fire-rated glazed wall and/or window system, dual aluminum cover cap format at window profiles.
      a. Face widths available:
         1) 2"
         2) Custom extruded aluminum cover caps.
      b. Duration – Windows Capable of providing a fire rating for 120 minutes.
         1) Basis of design (or equal):
            a) Frames: TGP Fireframes Aluminum Series.
            b) Glazing: Pilkington Pyrostop 120-106.
      c. Duration – Doors: Capable of providing a fire rating for 90 minutes.
         1) Basis of design (or equal):
            a) Frames: TGP Fireframes Designer Series.
            b) Glazing: Pilkington Pyrostop 90-102.

B. Structural Performance
   1. Accommodate movement between storefront and adjoining systems.

2.3 MATERIALS - GLASS

A. Refer to Section 088813 "Fire-Rated Glazing."

2.4 MATERIALS – ALUMINUM FRAMES

A. Aluminum Framing System 120 min.

B. Steel Frame — The steel framing members are made of two halves, nom. 1.9 in. wide (48.3 mm) with a nom. minimum depth of 1.38 in. (35 mm) with lengths cut according to glazing size.

C. Aluminum Trim — Supplied with the steel framing members. Nom. 2 in. (50.8 mm) wide with a nom. depth of 1.54 in. (39 mm) with lengths cut according to glazing size.

D. Stainless Steel Standoffs — Supplied with the steel framing members. Nom 5/16 in. (8 mm) diameter with a nom. minimum depth of 1 1/8 in. (28 mm) with depth adjusted to match Pilkington Pyrostop® Panel thickness.

E. Stainless Steel Moment and Connecting Braces: — Supplied with the steel framing members. Nom 3/8 in. (10 mm) thick with a nom. minimum depth of 1 1/8 in. (28 mm) with depth adjusted to match Pilkington Pyrostop® Panel thickness.

F. Framing Member Fasteners — Supplied with the steel framing members. Screws are M6 x16mm Button Head Socket Cap Screws for frame assembly and #6 x 1" Pan Head Sheet Metal Screws for door installation.

G. Glazing Gasket —
1. Interior Gasketing-Supplied with the steel framing members. Nom. 3/4 in. (19 mm) x 3/16 (4.5 mm) black applied to the steel framing members to cushion and seal the glazing material when installed.

H. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
1. Extruded Bars, Rods, Shapes, and Tubes: ASTM B 221 (ASTM B 221M).

I. Steel Reinforcement: With manufacturer's standard corrosion-resistant primer complying with SSPC-PS Guide No. 12.00 applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M Standard Specification for Carbon Structural Steel
2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable
3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength

J. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
1. Where fasteners are subject to loosening or turn out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
2. Reinforce members as required to receive fastener threads.

2.5 MATERIALS – STEEL FRAMES AND DOORS

A. Steel Framing System including 90-minute rated doors, 90-minute rated windows.
1. Frame: [Steel] [brushed stainless steel (up to 45 minute rating)] profiled formed tubing.
2. Fasteners: As recommended by manufacturer
3. Glazing Accessories: calcium silicate setting blocks.

1) When glazed with Pilkington Pyrostop (60-90 minutes) glazing products, doors meet the maximum transmitted temperature rise of not more than 450 degrees Fahrenheit (250 degrees Celsius) at the end of 30 minutes of the standard fire test exposure.

2.6 ENTRANCE DOOR HARDWARE

A. Before retaining hardware, verify accessible entrance, means-of-egress doorway, and other requirements of authorities having jurisdiction.

2.7 Accessories

A. Fasteners: Use fasteners fabricated from Type 304 or Type 316 stainless steel.

B. Glazing Compounds: As supplied by frame manufacturer appropriate for the application.

C. Intumescent Tape: As supplied by frame manufacturer.

D. Setting Blocks: ¼" Calcium silicate.

E. Perimeter Anchors: Steel.

F. Silicone Sealant: One-Part Low Modulus, neutral cure High Movement-Capable Sealant: Type S; Grade NS; Class 25 with additional movement capability of 100 percent in extension and 50 percent in compression (total 150 percent); Use (Exposure) NT; Uses (Substrates) M, G, A, and O as applicable. (Use-O joint substrates include: Metal factory-coated with a high-performance coating; galvanized steel; ceramic tile.)
   1. Available Products:
      a. Dow Corning 790, 795 - Dow Corning Corp.
      b. Momentive
      c. Tremco

G. Intumescent Caulk: Single component, latex-based, intumescent caulk designed to stop passage of fire, smoke, and fumes through fire-rated separations; permanently flexible after cure; will not support mold growth; flame spread/smoke developed 10/10.
   1. Available Products:
      a. 3M CP 25WB+

2.8 SLAG-WOOL-FIBER/ROCK-WOOL-FIBER INSULATION

A. Available Manufacturers:
   1. Fibrex Insulations Inc.
   2. Owens Corning
   3. Thermafiber.

4. Rockwool

B. Unfaced, Slag-Wool-Fiber/Rock-Wool-Fiber Board Insulation: ASTM C 612, maximum flame-spread and smoke-developed indexes of 15 and 0, respectively; passing ASTM E 136 for combustion characteristics; and of the following nominal density and thermal resistivity:
   1. Nominal density of 4 lb/cu. ft. (64 kg/cu. m), Types IA and IB, thermal resistivity of 4 deg F x h x sq. ft./Btu x in. at 75 deg F (27.7 K x m/W at 24 deg C).
   2. Fiber Color: Regular color, unless otherwise indicated.

2.9 FABRICATION

A. Obtain reviewed shop drawings prior to fabrication.

B. Fabrication Dimensions: Fabricate fire-rated assembly to field dimensions.

C. Factory prepared, fire-rated steel door assemblies by TGP to be prehung, prefinished with hardware preinstalled for field mounting.

D. Field glaze door and frame assemblies.

2.10 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish frames after assembly.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable. Noticeable variations in the same piece are not acceptable.

D. Powder coat finish systems offered and provided by Technical Glass Products are manufactured by Tiger Drylac which is a hybrid powder coating for interior applications based on a blend of epoxy-polyester.

2.11 FINISHES

A. Finish after fabrication.

B. Finish: PVDF.
   1. Color: To match architect's sample: UC701149F Duranar Sunstorm Dark Bronze (PPG).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Site Verification of Conditions: Verify substrate conditions (which have been previously installed under other sections) are acceptable for product installation in accordance with manufacturer's instructions. Verify openings are sized to receive curtain wall system and sill plate is level in accordance with manufacturer's acceptable tolerances.

B. Notify Architect of any conditions which jeopardize the integrity of the proposed fire wall / door system.

C. Do not proceed until such conditions are corrected.

3.2 INSTALLATION

A. Refer to manufacturer's written installation instructions.

3.3 REPAIR AND TOUCH UP

A. Anodized Finishes
   1. Protect the anodized finish from harsh chemicals such as concrete/mortar or muriatic acid/brick wash. If reasonable care is taken during handling and high and low pH chemicals can be avoided, repair and/or touch-up of an anodize finish will not be needed.
   2. Some rub marks on an anodized surface can be removed with a mild abrasive pad such as a Scotch-Brite pad prior to touch up painting.
   3. Touch-up paint should be used even more sparingly over anodize. Only the visible raw aluminum in the scratch or gouge should be touched up with a matching paint.

B. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged.

3.4 PROTECTION AND CLEANING

A. Protect 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.
   1. Do not clean with astringent cleaners. Use a clean "grit free" cloth and a small amount of mild soap and water or mild detergent.
   2. Do not use any of the following:
      a. Steam jets
      b. Abrasives
      c. Strong acidic or alkaline detergents, or surface-reactive agents
      d. Detergents not recommended in writing by the manufacturer
      e. Do not use any detergent above 77 degrees F
      f. Organic solvents including but not limited to those containing ester, ketones, alcohols, aromatic compounds, glycol ether, or halogenated hydrocarbons.
      g. Metal or hard parts of cleaning equipment must not touch the glass surface

B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended by glass manufacturer.

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 by glass manufacturer.

PART 4 - END OF SECTION

SECTION 084413 - GLAZED ALUMINUM CURTAIN WALLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glazed aluminum curtain wall systems:
   a. NOTE: The calculations for basis of design system have been submitted to the Division of the State Architect.
      1) Any substitutions will require submittal of the curtainwall system to Division of the State Architect as a revision. Compensation for the time of the Design Team and DSA Reviewers will be paid by the General Contractor.
   b. Conventionally glazed.
   c. Vertical fin cover caps.
   d. Spandrel glass panels.
   e. Venting Windows
      1) Window position sensors – factory installed.

B. Related Sections:
1. Section 078443 "Joint Firestopping" perimeter fire-containment systems field installed with glazed aluminum curtain walls.
2. 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.
3. Section 084113 “Aluminum Framed Entrances and Storefronts” for doors.
4. Section 085413 “Door Hardware”.
5. Section 088000 "Glazing" for curtain wall glazing.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

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 glazed aluminum curtain walls. Include 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 type of vertical-to-horizontal intersection of glazed aluminum curtain walls, showing the following:

    a. Joinery, including concealed welds.
    b. Anchorage.
    c. Expansion provisions.
    d. Glazing.
    e. Flashing and drainage.
    f. Joint Firestopping

3. Show connection to and continuity with adjacent thermal, fire, weather, air, and vapor barriers.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Delegated-Design Submittal for Substitutions: For glazed aluminum curtain walls, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data:

1. For Installer.
2. For substitutions: For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the jurisdiction in which Project is located.

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.

C. Product Test Reports: For glazed aluminum curtain walls, for tests performed by a qualified testing agency.

D. Quality-Control Program: Developed specifically for Project, including fabrication and installation, in accordance with recommendations in ASTM C1401. Include periodic quality-control reports.

E. Source quality-control reports.

F. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For glazed aluminum curtain walls to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer and that employs a qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AGM) contractors and that employs glazing technicians certified under the Architectural Glass and Metal Technician (AGMT) certification program.

B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.7 MOCKUPS

A. Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical wall area as shown on Drawings.
2. Testing shall be performed on mockups in accordance with requirements in "Field Quality Control" Article.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 WARRANTY

A. Special Assembly Warranty: Manufacturer agrees to repair or replace components of glazed aluminum curtain wall that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.
b. Noise or vibration created by wind and thermal and structural movements.
c. Deterioration of metals[, metal finishes,] and other materials beyond normal weathering.
d. Water penetration through fixed glazing and framing areas.
e. Failure of operating components.

2. Warranty Period: 10 years from date of Substantial Completion.

B. Special Finish Warranty, Anodized Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, peeling, or chipping.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS FOR SUBSTITUTIONS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazed aluminum curtain walls.

B. General Performance: Comply with performance requirements specified, as determined by testing of glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Glazed aluminum curtain walls shall withstand movements of supporting structure, including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:

a. Thermal stresses transferring to building structure.
b. Glass breakage.
c. Noise or vibration created by wind and thermal and structural movements.
d. Loosening or weakening of fasteners, attachments, and other components.
e. Failure of operating units.

C. Structural Loads:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.

D. Deflection of Framing Members Supporting Glass: At design wind load, as follows:

1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans of up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans of greater than 13 feet 6 inches (4.1 m).
2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which

reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch (3.2 mm).

a. Operable Units: Provide a minimum 1/16-inch (1.6-mm) clearance between framing members and operable units.

E. Structural: Test in accordance with ASTM E330/E330M 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. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).

G. Water Penetration under Dynamic Pressure: Test in accordance with 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 6.24 lbf/sq. ft. (300 Pa).
2. Maximum Water Leakage: In accordance with AAMA 501.1. Water leakage does not include water controlled by flashing and gutters or water that is drained to exterior.

H. Interstory Drift: Accommodate design displacement of adjacent stories indicated.

1. Design Displacement: As indicated on Drawings.
2. Test Performance: Complying with criteria for passing based on building occupancy type when tested in accordance with AAMA 501.4 at design displacement[and 1.5 times the design displacement].

I. Seismic Performance: Glazed aluminum curtain walls shall withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.

1. Seismic Drift Causing Glass Fallout: Complying with criteria for passing based on building occupancy type when tested in accordance with AAMA 501.6 at design displacement and 1.5 times the design displacement.
2. Vertical Interstory Movement: Complying with criteria for passing based on building occupancy type when tested in accordance with AAMA 501.7 at design displacement and 1.5 times the design displacement.

J. Energy Performance: Certified and labelled by manufacturer for energy performance as follows:

1. Thermal Transmittance (U-factor):

    a. Fixed Glazing and Framing Areas: U-factor for the system of not more than 0.41 Btu/sq. ft. x h x deg F (2.33 W/sq. m x K) as determined in accordance with NFRC 100.
    b. Venting Windows: Whole window U-factor of not more than 0.30 Btu/sq. ft. x h x deg F (1.70 W/sq. m x K) as determined in accordance with NFRC 100.

2. Solar Heat Gain Coefficient (SHGC):

    a. Fixed Glazing and Framing Areas: SHGC for the system of not more than 0.26 as determined in accordance with NFRC 200.
    b. Venting Windows: Whole-window SHGC of not more than 0.23 as determined in accordance with NFRC 200.

3. Air Leakage:

    a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa) when tested in accordance with ASTM E283.
    b. Venting Windows: Whole-window air leakage of not more than 0.3 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 6.24 lbf/sq. ft. (300 Pa) when tested in accordance with AAMA/WDMA/CSA 101/I.S.2/A440.

4. Condensation Resistance Factor (CRF):

    a. Fixed Glazing and Framing Areas: CRF for the system of not less than 55 as determined in accordance with AAMA 1503.
    b. Venting Windows: Whole-window CRF of not less than 52 as determined in accordance with AAMA 1503.

K. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

L. Sustainable Design Performance Requirements:
1. Interior sealants shall comply with the following:
    a. Low-Emitting Materials: Testing and product requirements of the California Department of Health Services CDPH Standard Method v1.1, using CA Section 01350, Appendix B, New Single-Family Residence Scenario.

2.2 SOURCE LIMITATIONS

A. Obtain all components of curtain-wall system and storefront system, including framing spandrel panels, venting windows, entrances, sun control, and accessories, from single manufacturer.

2.3 GLAZED ALUMINUM CURTAIN WALL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Arcadia, Inc.
   2. EFCO Corporation.
   3. Kawneer North America, an Arconic company.
   4. Oldcastle Building Envelope.
   5. Peerless Door & Glass LLC.
   6. YKK AP America Inc.

B. Basis of Design – submitted to Division of the State Architect with calculations:
   1. Arcadia T500 (OPG 6000).
      a. Fins: 9" deep cover caps at vertical framing members except at doors as indicated. Color to match framing system.
      b. Drywall adapter profiles: At interior low walls. Color to match framing system.

C. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

   1. Construction: Thermally broken.
   2. Glazing System: Retained mechanically with gaskets on four sides.
   3. Glazing Plane: Front.
   4. Finish: Color anodic finish.
   5. System: Stick system.
   6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
   7. Steel Reinforcement: As required by manufacturer.

D. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.

   1. Include snap-on aluminum trim that conceals fasteners.

   2. Fins: Also include 9" deep cover caps at vertical profiles.

E. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

F. Insulated Glass Spandrel Panels **S1**:
   1. Laminated, glass-faced, ceramic-backed flat panels with no deviations in plane exceeding 0.8 percent of panel dimension in width or length.
   2. Provide Basis of Design: Mapes, MAPESPAN, or approved equal.

      a. Overall Panel Thickness: 1 inch (25.4 mm).
      b. Exterior Skin: Glass, tempered.

         1) Thickness: ¼".
         2) Finish: Ceramic frit on #2 surface.
         3) Color: Subdued Gray.
         4) Substrate: Cement Board.

c. Interior Skin: Aluminum.

1) Thickness: Manufacturer's standard for finish and texture indicated.
2) Finish: Mill finish (concealed surfaces).
3) Texture: Smooth.

d. Thermal Insulation Core: Manufacturer's standard polyisocyanurate board.
e. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

G. Metal-faced Spandrel Panels – Finished Interior Face **S2**:
1. Laminated, aluminum-faced, ceramic-backed flat panels with no deviations in plane exceeding 0.8 percent of panel dimension in width or length.
2. Provide Basis of Design: Mapes, Mapes-R Infill Panel, or approved equal.

a. Overall Panel Thickness: 1 inch (25.4 mm).
b. Exterior Skin: Aluminum, PVDF coated.

1) Minimum Thickness: 0.032 inch.
2) Finish: Manufacturer's standard PVDF coating on #1 surface.
3) Color: To match architect's sample:
a) UC106712XL Duranar XL Summer Suede Metallic (PPG).
4) Substrate: Cement Board.

c. Interior Skin: Aluminum, PVDF coated.

1) Minimum Thickness: 0.032 inch.
2) Finish: Manufacturer's standard PVDF coating on #1 surface.
3) Color: To match architect's sample:
a) UC106712XL Duranar XL Summer Suede Metallic (PPG).
4) Substrate: Cement Board.

d. Thermal Insulation Core: Manufacturer's standard polyisocyanurate board.
e. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

H. Metal-faced Spandrel Panels – Concealed Interior Face **S3**:
1. Laminated, aluminum-faced, ceramic-backed flat panels with no deviations in plane exceeding 0.8 percent of panel dimension in width or length.
2. Provide Basis of Design: Mapes, Mapes-R Infill Panel, or approved equal.

a. Overall Panel Thickness: 1 inch (25.4 mm).
b. Exterior Skin: Aluminum, PVDF coated.

1) Thickness: 0.032 inch.
2) Finish: Manufacturer's standard PVDF coating on #1 surface.
3) Color: To match architect's sample:
a) UC106712XL Duranar XL Summer Suede Metallic (PPG).
4) Substrate: Cement Board.

c. Interior Skin: Aluminum.

1) Thickness: Manufacturer's standard for finish and texture indicated.
2) Finish: Mill finish (concealed surfaces).
3) Texture: Smooth.

d. Thermal Insulation Core: Manufacturer's standard polyisocyanurate board.
e. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

I. Venting Windows:
1. Manufacturer's standard units, complying with AAMA/WDMA/CSA 101/I.S.2/A440, with self-flashing mounting fins, and as follows:

a. Window Type: As indicated on Drawings.

1) Cam handle locking system at or near bottom of window for accessibility compliant with ADA requirements. Operation to be by closed fist, maximum 5 pounds of force and within accessible reach ranges in compliance with CBC 11B-309.4 and 11B-229.1.
2) Multi-point locking system.
3) Limit Devices: limit devices designed to restrict sash opening.

a) Limit clear opening to 4 inches (100 mm) for ventilation; with custodial key release.
b) Installed at windows adjacent to a walking path or with sill more than 72" above exterior finish grade.

b. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.
c. Insect Screens: Provide removable insect screen on each operable exterior sash, with screen frame finished to match window unit, complying with SMA 1004 or SMA 1201, and as follows:
1) Fabric: Manufacturer's standard aluminum wire fabric.

d. Glazing: Same as adjacent glazed aluminum curtain-wall glazing.
e. Finish: Match adjacent glazed aluminum curtain-wall finish.
f. Window position sensors: Installed by contractor with concealed wiring.

J. Entrance Door Systems: Comply with Section 084113 "Aluminum-Framed Entrances and Storefronts".

2.4 SUN CONTROL

A. Vertical Fins: Assemblies consisting of manufacturer's standard cover caps.

1. Orientation: Vertical.
2. Fins: 9" deep cover caps.
3. Shape: Rectangular.
4. Finish: Match adjacent glazed aluminum curtain wall.

5. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
6. Steel Reinforcement: As required by manufacturer.

2.5 GLAZING

A. Glazing: Comply with Section 088000 "Glazing."

B. Glazing Gaskets: ASTM C509 or ASTM C864. Manufacturer's standard.

1. Color: Black.

2.6 MATERIALS

A. Sheet and Plate: ASTM B209 (ASTM B209M).

B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).

C. Structural Profiles: ASTM B308/B308M.

D. Steel Reinforcement:

1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.

E. Steel Reinforcement Primer: 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 in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.

2.7 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.

B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch (25.4 mm) that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

C. Concealed Flashing: Dead-soft, 0.018-inch- (0.457-mm-) thick stainless steel, ASTM A240/A240M of type recommended by manufacturer.

D. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

2.8 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. 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.

C. 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.

D. Curtain-Wall Framing: Fabricate components for assembly using manufacturer's standard assembly method.

2.9 ALUMINUM FINISHES

A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
1. Color: Medium Dark Bronze. (Basis of Design Arcadia AB5).

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 INSTALLATION, GENERAL

A. Comply with manufacturer's written instructions.

B. Do not install damaged components.

C. Fit joints to produce hairline joints free of burrs and distortion.

D. Rigidly secure nonmovement joints.

E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.

F. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.

G. Seal joints watertight unless otherwise indicated.

H. 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 with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

I. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

J. Install components plumb and true in alignment with established lines and grades.

3.3 INSTALLATION OF OPERABLE UNITS

A. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

3.4 INSTALLATION OF GLAZING

A. Install glazing as specified in Section 088000 "Glazing."

3.5 ERECTION TOLERANCES

A. Install glazed aluminum curtain walls to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
2. Level: 1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
3. Alignment:

a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (12.7 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).

b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (12.7 to 25.4 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).
c. Where surfaces are separated by reveal or protruding element of 1 inch (25.4 mm) wide or more, limit offset from true alignment to 1/4 inch (6 mm).

4. Location: Limit variation from plane to 1/8 inch in 12 feet (3.2 mm in 3.6 m); 1/2 inch (12.7 mm) over total length.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Test Area: Perform tests on mockup.

C. Field Quality-Control Testing: Perform the following test on mockups.

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested in accordance with AAMA 501.2 and shall not evidence water penetration.

a. Perform a minimum of two tests in areas as directed by Architect.

2. Air Leakage: ASTM E783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. (0.45 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).

a. Perform a minimum of two tests in areas as directed by Architect.

D. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.

END OF SECTION 084413

SECTION 085413 - FIBERGLASS WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Fiberglass-framed windows.
a. Window position sensors – factory installed.

B. Related Sections:
1. Section 071326 “Self-Adhering Sheet Flashing”.
2. Section 088000 “Glazing.”
3. Section 088700 “Glazing Surface Films” for restroom windows color and obscuring films.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:
1. Material Ingredient Reporting: Declare label.

C. Shop Drawings: Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.

D. Water Testing Plan: Identify methods and locations of

E. Samples: For each exposed product and for each color specified.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of fiberglass window, for tests performed by a qualified testing agency.

B. Field Test Reports: For field quality-control testing.

C. Sample Warranties: For manufacturer's warranties.

1.5 QUALITY ASSURANCE

A. Qualifications:

1. Testing Agency: Qualified in accordance with ASTM E699 for testing indicated and acceptable to Owner and Architect.

B. Pre-construction Testing

1.6 MOCKUPS

A. Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
1. Location: As approved 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.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace fiberglass windows 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, water leakage, and air infiltration.
c. Faulty operation of movable sash and hardware.
d. Deterioration of materials and finishes beyond normal weathering.
e. Failure of insulating glass.
2. Warranty Period:
a. Window: 10 years from date of Substantial Completion.
b. Glazing Units: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 WINDOW PERFORMANCE REQUIREMENTS

A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
1. Window Certification: WDMA certified with label attached to each window.

B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:
1. Minimum Performance Class: CW.
2. Minimum Performance Grade: 50.

C. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:
1. No evidence of water penetration through fixed glazing and framing areas when tested in accordance with a minimum static-air-pressure differential of 15 lbf/sq. ft.

D. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.24 Btu/sq. ft. x h x deg F.

E. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.35.

2.2 FIBERGLASS WINDOWS

A. Basis-of-Design Product: Subject to compliance with requirements, provide the following or approved equal:
1. Cascadia Windows and Doors; Universal Series.
a. Contact:
Cameron Hendrix
chendrix@cascadiawindows.com
720-666-9901
604-857-4600
#101 5350B 275th Street, Langley, BC, Canada V4W 0C1

B. Operating Types: Provide the following operating types in locations indicated on Drawings:
1. Fixed.
2. Casement.
a. Hardware: Provide manufacturer's standard ADA compliant operating hardware. Operation to be by closed fist, maximum 5 pounds of force and within accessible reach ranges in compliance with CBC 11B-309.4 and 11B-229.1.
1) Color: Black.

C. Frames and Sashes: Pultruded fiberglass complying with AAMA/WDMA/CSA 101/I.S.2/A440 and with exposed exterior fiberglass surfaces finished with manufacturer's standard enamel coating complying with AAMA 625.
1. Exterior Color: Basis of design for key indicated in window schedule:
a. **FG-1**: Cascadia Windows and Doors 872 Commercial Brown.
b. **FG-2**: Custom Color Match: UC106685F Duranar Sunstorm Silverstorm (PPG).
c. **FG-3**: Custom Color Match: 399Q0076 Fluropon Continuum Interstellar (Sherwin Williams).
2. Interior Finish: Matching exterior color and finish.

D. Insulating-Glass Units: Refer to Section 088000 "Glazing" for products as indicated in window schedule.

E. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.

F. Fasteners: Stainless steel and compatible with window members, trim, hardware, anchors, and other components.

1. Exposed Fasteners: Do not use exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

2.3 ACCESSORIES

A. Head, Jamb, and Sill Receptors: Provide manufacturer's standard receptors matching window frame finishes.

B. Window Film: Refer to Section 088700 “Glazing Surface Films.”

C. Window position sensors: Factory installed by window manufacturer with concealed wiring.

D. Window screens: Manufacturer’s interior mounted standard screens.

2.4 FABRICATION

A. Fabricate fiberglass windows in sizes indicated. Include a complete system for installing and anchoring windows.

B. Glaze fiberglass windows in the factory.

C. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections. Provide mullions and cover plates capable of withstanding design wind loads of window units.

D. 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 INSTALLATION

A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E2112.

B. Install windows level, plumb, square, true to line, without distortion, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.

C. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.

D. Clean exposed surfaces immediately after installing windows. Remove excess sealants, glazing materials, dirt, and other substances.

E. Remove and replace sashes if glass has been broken, chipped, cracked, abraded, or damaged during construction period.

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
   1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.

B. Testing Services: Testing and inspecting of installed windows shall take place as follows:
   1. Testing Methodology: Testing of windows for air infiltration and water resistance shall be performed according to AAMA 502.
   2. Water-Resistance Testing:
      a. Test Pressure: 10 lbf/sq. ft.
      b. Allowable Water Infiltration: No water penetration.
   3. Testing Extent: Three windows of each type as selected by Architect and a qualified independent testing and inspecting agency. Windows shall be tested after perimeter sealants have cured.
   4. Test Reports: Prepared according to AAMA 502.

C. Coordination:
   1. Provide testing agency access to the test specimen from the exterior.
   2. Provide wood framed test chamber at the interior of the test specimen as directed by testing agency.
   3. Provide access to water source and two 20 amp circuits within the vicinity of the test.

D. Windows will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.3 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.

B. Clean exposed surfaces immediately after installing windows. Remove excess sealants, glazing materials, dirt, and other substances.
   1. Keep protective films and coverings in place until final cleaning.

C. Remove and replace sashes if glass has been broken, chipped, cracked, abraded, or damaged during construction period.

D. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

END OF SECTION

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Door hardware, including electric hardware.
2. Wall or floor-mounted electromagnetic hold-open devices.
3. Power supplies for electric hardware.
4. Door operators.

B. Related Divisions:

1. Division 07 – sealant at exterior thresholds
2. Division 08 – metal doors and frames, interior aluminum frames, wood doors, integrated security systems, specialty doors, storefront and glazed curtainwall systems.
3. Division 21 – fire and life safety systems
4. Division 28 – security access systems

C. Specific Omissions: Hardware for the following is specified or indicated elsewhere.

1. Windows.
2. Cabinets, including open wall shelving and locks.
3. Signs, except where scheduled.
4. Toilet accessories, including grab bars.
5. Installation.
6. Rough hardware.
7. Conduit, junction boxes & wiring.
8. Folding partitions, except cylinders where detailed.
9. Access doors and panels, except cylinders where detailed.
10. Corner Guards.
11. Welded steel gates and supports.
12. Mechanical screen gates.

1.2 REFERENCES:

A. Use date of standard in effect as of Bid date.

1. American National Standards Institute
   a) ANSI 156.18 – Materials and Finishes.
2. BHMA – Builders Hardware Manufacturers Association
3. 2022 California Building Code
   a) Chapter 11B – Accessibility To Public Buildings, Public Accommodations, Commercial Buildings and Public Housing
4. DHI – Door and Hardware Institute

5. NFPA – National Fire Protection Association
    a) NFPA 80 2022 Edition – Standard for Fire Doors and Other Opening Protectives.
    b) NFPA 105 – Smoke and Draft Control Door Assemblies
    c) NFPA 252 – Fire Tests of Door Assemblies
6. UL – Underwriters Laboratories
    a) UL10C – Positive Pressure Fire Tests of Door Assemblies.
    b) UL 305 – Panic Hardware
7. WHI – Warnock Hersey Incorporated State of California Building Code
8. Local applicable codes
9. SDI – Steel Door Institute
10. WI – Woodwork Institute
11. AWI – Architectural Woodwork Institute
12. NAAMM – National Association of Architectural Metal Manufacturers

B. Abbreviations

1. Manufacturers: see table at 2.1.A of this section
2. Finishes: see 2.8 of this section.

1.3 SUBMITTALS & SUBSTITUTIONS

A. SUBMITTALS: Organize vertically formatted schedule into "Hardware Sets" with index of doors and headings, indicating complete designations of every item required for each door or opening. Minimum 10pt font size. Include following information:

1. Type, style, function, size, quantity and finish of hardware items.
2. Use BHMA Finish codes per ANSI A156.18.
3. Name, part number and manufacturer of each item.
4. Fastenings and other pertinent information.
5. Location of hardware set coordinated with floor plans and door schedule.
6. Explanation of abbreviations, symbols, and codes contained in schedule.
7. Mounting locations for hardware.
8. Door and frame sizes, materials and degrees of swing.
9. List of manufacturers used and their nearest representative with address and phone number.
10. Catalog cuts.
11. Point-to-point wiring diagrams.
12. Manufacturer's technical data and installation instructions for electronic hardware.

B. Bid and submit manufacturer's updated/improved item if scheduled item is discontinued.

C. Deviations: Highlight, encircle or otherwise identify deviations from "Schedule of Finish Hardware" on submittal with notations clearly designating those portions as deviating from this section.

D. If discrepancy between drawings and scheduled material in this section, bid the more expensive of the two choices, note the discrepancy in the submittal and request direction from Architect for resolution.

E. Substitutions per Division 1. Include product data and indicate benefit to the Project. Furnish operating samples on request.

F. Items listed with no substitute manufacturers have been requested by Owner to meet existing standard.

G. Furnish as-built/as-installed schedule with closeout documents, including keying schedule, riser and point-to-point wiring diagrams, manufacturers' installation, adjustment and maintenance information, and supplier's final inspection report.

1.4 QUALITY ASSURANCE:

A. Qualifications:

1. Hardware supplier: direct factory contract supplier who employs a certified architectural hardware consultant (AHC), available at reasonable times during course of work for project hardware consultation to Owner, Architect and Contractor.

a) Responsible for detailing, scheduling and ordering of finish hardware. Detailing implies that the submitted schedule of hardware is correct and complete for the intended function and performance of the openings.

B. Hardware: Free of defects, blemishes and excessive play. Obtain each kind of hardware (latch and locksets, exit devices, hinges and closers) from one manufacturer.

C. Exit Doors: Operable from inside with single motion without the use of a key or special knowledge or effort.

D. Fire-Rated Openings: NFPA 80 compliant. Hardware UL10C (positive pressure) compliant for given type/size opening and degree of label. Provide proper latching hardware, non-flaming door closers, approved-bearing hinges, and resilient seals. Coordinate with wood door section for required intumescent seals. Furnish openings complete.

E. Furnish hardware items required to complete the work in accordance with specified performance level and design intent, complying with manufacturers' instructions and code requirements.

F. Pre-Installation Meetings: Initiate and conduct with supplier, installer and related trades, coordinate materials and techniques, and sequence complex hardware items and systems installation. Include manufacturers' representatives of locks, panic hardware and door closers in the meetings. Convene prior to commencement of related work.

1.5 DELIVERY, STORAGE AND HANDLING:

A. Delivery: coordinate delivery to appropriate locations (shop or field).

1. Permanent keys and cores: secured delivery direct to Owner's representative.

B. Acceptance at Site: Items individually packaged in manufacturers' original containers, complete with proper fasteners and related pieces. Clearly mark packages to indicate contents, locations in hardware schedule and door numbers.

C. Storage: Provide securely locked storage area for hardware, protect from moisture, sunlight, paint, chemicals, dust, excessive heat and cold, etc.

1.6 PROJECT CONDITIONS AND COORDINATION:

A. Where exact types of hardware specified are not adaptable to finished shape or size of members requiring hardware, provide suitable types having as nearly as practical the same operation and quality as type specified, subject to Architect's approval.

B. Coordination: Coordinate hardware with other work. Furnish hardware items of proper design for use on doors and frames of the thickness, profile, swing, security and similar requirements indicated, as necessary for proper installation and function, regardless of omissions or conflicts in the information on the Contract Documents. Furnish related trades with the following information:

1. Location of embedded and attached items to concrete.
2. Location of wall-mounted hardware, including wall stops.
3. Location of finish floor materials and floor-mounted hardware.
4. At masonry construction, coordinate with the anchoring and hollow metal supplier prior to frame installation by placing a strip of insulation, wood, or foam, on the back of the hollow metal frame behind the rabbet section for continuous hinges, as well as at rim panic hardware strike locations, silencers, coordinators, and door closer arm locations. When the frame is grouted in place, the backing will allow drilling and tapping without dulling or breaking the installer's bits.
5. Locations for conduit and raceways as needed for electrical, electronic and electro-pneumatic hardware items. Fire/life-safety system interfacing. Point-to-point wiring diagrams plus riser diagrams to related trades.
6. Coordinate: flush top rails of doors at outswinging exteriors, and throughout where adhesive-mounted seals occur.
7. Manufacturers' templates to door and frame fabricators.

C. Check Shop Drawings for doors and entrances to confirm that adequate provisions will be made for proper hardware installation.

D. Environmental considerations: segregate unused recyclable paper and paper product packaging, uninstalled metals, and plastics, and have these sent to a recycling center.

1.7 WARRANTY:

A. Part of respective manufacturers' regular terms of sale. Provide manufacturers' written warranties.

B. Include factory order numbers with close-out documents warranty information:

C. Minimum warranties:

1.	Locksets:	Three years
2.	Extra Heavy Duty Cylindrical Lock:	Seven Years
3.	Exit Devices:	Three years mechanical One year electrical
4.	Closers:	Thirty years mechanical Two years electrical
5.	Hinges:	One year
6.	Other Hardware	Two years

1.8 MODEL UNIT:

A. For residential units, install one set of door hardware complete for review and approval by owner prior to continuing installation of the remaining door hardware sets of the same type.

1.9 COMMISSIONING:

A. Conduct these tests prior to request for certificate of substantial completion:

1. With installer present, test door hardware operation with climate control system and stairwell pressurization system both at rest and while in full operation.
2. With installer, access control contractor and electrical contractor present, test electrical, electronic and electro-pneumatic hardware systems for satisfactory operation.
3. With installer and electrical contractor present, test hardware interfaced with fire/life-safety system for proper operation and release.

A. Final inspection: Installer to provide letter to Owner that upon completion installer has visited the Project and has accomplished the following:

1. Has re-adjusted hardware.
1. Has evaluated maintenance procedures and recommend changes or additions, and instructed Owner's personnel.
2. Has identified items that have deteriorated or failed.
3. Has submitted written report identifying problems.

1.10 DEMONSTRATION:

A. Demonstrate mechanical hardware and electrical, electronic and pneumatic hardware systems, including adjustment and maintenance procedures.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Listed acceptable alternate manufacturers: these will be considered; submit for review products with equivalent function and features of scheduled products.

ITEM:	MANUFACTURER:	ACCEPTABLE ALTERNATE:
Hinges	(IVE) Ives	Bommer
Key System	(C-R) Corbin Russwin	Owner standard
Mechanical Locks	(C-R) Corbin Russwin	Schlage L Series
Electronic Locks	(SCE) Schlage Electronics	Owner standard
Exit Devices	(VON) Von Duprin	Owner standard
Closers	(LCN) LCN	Owner standard
Auto Flush Bolts	(IVE) Ives	DCI
Coordinators	(IVE) Ives	DCI
Silencers	(IVE) Ives	Rockwood, Trimco
Kickplates	(IVE) Ives	Rockwood, Trimco
Stops & Holders	(IVE) Ives	Rockwood, Trimco
Thresholds	(ZER)Zero	NGP, Reese
Seals & Bottoms	(ZER)Zero, (PEM) Pemko	NGP, Reese

2.2 HINGING METHODS:

B. Drawings typically depict doors at 90 degrees, doors will actually swing to maximum allowable. Use wide-throw conventional or continuous hinges as needed up to 8 inches in width to allow door to stand parallel to wall for true 180-degree opening. Advise architect if 8-inch width is insufficient.

C. Doors 3'6" or wider use 5" X 41/2" heavy weight hinges

D. Doors 8'0" use 4 hinges and add 1 hinge for every foot thereafter

E. Conform to manufacturer's published hinge selection standard for door dimensions, weight and frequency, and to hinge selection as scheduled. Where manufacturer's standard exceeds the scheduled product, furnish the heavier of the two choices, notify Architect of deviation from scheduled hardware.

F. Conventional Hinges: Steel or stainless steel pins and approved bearings. Hinge open widths minimum, but of sufficient throw to permit maximum door swing.

1. Outswinging exterior doors: stainless steel hinges with non-removable (NRP) pins and security studs.
2. Stainless steel material exteriors and at doors subject to corrosive atmospheric conditions.

2.3 LOCKSETS, LATCHSETS, DEADBOLTS:

A. Mortise Locksets and Latchsets: as scheduled.

1. Chassis: cold-rolled steel, handing field-changeable without disassembly.
2. Floating mounting tabs automatically adjusts to fit a beveled door edge.
3. Latchbolts: 0.75 inch throw stainless steel anti-friction type.
4. Lever Trim: through-bolted, accessible design, cast lever or solid extruded bar type levers as scheduled. Filled hollow tube design unacceptable.
    a) Spindles: security design independent breakaway. Breakage of outside lever does not allow access to inside lever's hubworks to gain wrongful entry.
    b) Inside lever applied by screwless shank mounting – no exposed trim mount screws.
    c) Levers rotate up or down for ease of use.
5. Furnish solid cylinder collars with wave springs. Wall of collar to cover rim of mortise cylinder.
6. Turnpieces: accessible offset turn-lever design not requiring pinching or twisting motions to operate.
7. Deadbolts: stainless steel 1-inch throw.
8. Electric operation: Manufacturer-installed continuous duty solenoid.
9. Strikes: 16 gage curved steel, bronze or brass with 1 inch deep box construction, lips of sufficient length to clear trim and protect clothing.
10. Scheduled Lock Series and Design: Corbin Russwin NSA
11. Certifications:
    a) ANSI A156.13, 1994, Grade 1 Operational,
    b) ANSI/ASTM F476-84 Grade 31 UL Listed.
12. Accessibility: Require not more than 5 lb to retract the latchbolt or deadbolt, or both, per CBC 2022 11B-404.2.7 and 11B-309.4.

2.4 EXIT DEVICES / PANIC HARDWARE

A. General features:

1. Independent lab-tested 1,000,000 cycles.
2. Push-through push-pad design. No exposed push-pad fasteners, no exposed cavities when operated. Return stroke fluid dampeners and rubber bottoming dampeners, plus anti-rattle devices.
3. Deadlocking latchbolts, 0.75 inch projection.
4. End caps: impact-resistant, flush-mounted. No raised edges or lips to catch carts or other equipment.
5. No exposed screws to show through glass doors.

6. Non-handed basic device design with center case interchangeable with all functions, no extra parts required to effect change of function.
7. Releasable in normal operation with 15-pound maximum operating force per UBC Standard 10-4, and with 32-pound maximum pressure under 250-pound load to the door.
8. Lever design to match locksets
9. Accessibility: Require not more than 5 lb to retract the latchbolt, per CBC 2022 11B-404.2.7 and 11B-309.4.
    a) Mechanical method: where touchpad directly retracts the latchbolt with 5 lb or less of force.

B. Specific features:

1. Non-Fire Rated Devices: standard dogging
2. Lever Trim: breakaway type, forged brass or bronze escutcheon min. 0.130 inch thickness, compression spring drive, match lockset lever design.
3. Fire-Labeled Devices: UL label indicating "Fire Exit Hardware". Vertical rod devices less bottom rod (LBR) unless otherwise scheduled.
4. Inpact recessed devices: 1.25 inch projection when push-pad is depressed. Sloped metal end caps to deflect carts, etc. No pinch points to catch skin between touchbar and door.
5. Electrically Operated Devices: Single manufacturer source for electric latch retraction devices, electrically controlled trim, power transfers, power supplies, monitoring switches and controls.

2.6 CLOSERS

A. Surface Closers: 4040-XP

1. Full rack-and-pinion type cylinder with removable non-ferrous cover and cast iron body. Double heat-treated pinion shaft, single piece forged piston, chrome-silicon steel spring.
2. ISO 2000 certified. Units stamped with date-of-manufacture code.
3. Independent lab-tested 10,000,000 cycles.
4. Non-sized, non-handed, and adjustable. Place closer inside building, stairs, and rooms.
5. Plates, brackets and special templating when needed for interface with particular header, door and wall conditions and neighboring hardware.
6. Adjust doors to open with not more than 5.0-pounds pressure to open at exterior doors and 5.0-pounds at interior doors. As allowed per 2022 California Building Code Section 11B-404.2.9, local authority may increase the allowable pressure for fire doors to achieve positive latching, but not to exceed 15-pounds.
    a) Exception: exterior doors' pressure-to-open may be increased to 8.5-pounds if: at a single location, and one of a bank of eight leafs or fraction of eight, and one leaf of this bank is fitted with a low- or high-energy operator.
7. Separate adjusting valves for closing speed, latching speed and backcheck, fourth valve for delayed action where scheduled.
8. Extra-duty arms (EDA) at exterior doors scheduled with parallel arm units.

9. Exterior door closers: tested to 100 hours of ASTM B117 salt spray test, furnish data on request.
10. Exterior doors: seasonal adjustments not required for temperatures from 120 degrees F to -30 degrees F, furnish checking fluid data on request.
11. Non-flaming fluid, will not fuel door or floor covering fires.
12. Pressure Relief Valves (PRV) not permitted.

B. Surface Closers: 1461

1. Full rack-and-pinion type cylinder with removable non-ferrous cover and cast iron body. Double heat-treated pinion shaft, single piece forged piston, chrome-silicon steel spring.
2. ISO 2000 certified. Units stamped with date-of-manufacture code.
3. Independent lab-tested 5,000,000 cycles.
4. Non-sized, non-handed and adjustable. Place closers inside building, stairs and rooms.
5. Plates, brackets and special templating when needed for interface with particular header, door and wall conditions and neighboring hardware.
6. Adjust doors to open with not more than 5.0-pounds pressure to open at exterior doors and 5.0-pounds at interior doors. As allowed per 2022 California Building Code Section 11B-404.2.9, local authority may increase the allowable pressure for fire doors to achieve positive latching, but not to exceed 15-pounds.
    a) Exception: exterior doors' pressure-to-open may be increased to 8.5-pounds if: at a single location, and one of a bank of eight leafs or fraction of eight, and one leaf of this bank is fitted with a low- or high-energy operator.
7. Separate adjusting valves for closing speed, latching speed and backcheck, fourth valve for delayed action where scheduled.
8. Extra-duty arms (EDA) at exterior doors scheduled with parallel arm units.
9. Exterior door closers: tested to 100 hours of ASTM B117 salt spray test, furnish data on request.
10. Exterior doors: seasonal adjustments not required for temperatures from 120 degrees F to 0 degrees F, furnish checking fluid data on request.
11. Non-flaming fluid, will not fuel door or floor covering fires.
12. Pressure Relief Valves (PRV) not permitted.

2.7 OTHER HARDWARE

A. Automatic Flush Bolts: Low operating force design.

B. Kick Plates: Four beveled edges, .050 inches minimum thickness, height and width as scheduled. Sheet-metal screws of bronze or stainless steel to match other hardware.

C. Door Stops: Provide stops to protect walls, casework or other hardware.

1. Unless otherwise noted in Hardware Sets, provide floor type with appropriate fasteners. Where floor type cannot be used, provide wall type. If neither can be used, provide overhead type.

2. Locate overhead stops for maximum possible opening. Consult with Owner for furniture locations. Minimum: 90deg stop / 95deg deadstop. Note degree of opening in submittal.

D. Automatic door bottoms: low operating force units.

1. Include automatic type door bottoms, as opposed to fixed sweeps, at stairs and elevator lobbies to allow fine-tuning of pressurization systems.

E. Thresholds: As scheduled and per details. Comply with CBC 2022 11B-404.2.5. Substitute products: certify that the products equal or exceed specified material's thickness. Proposed substitutions: submit for approval.

2. Saddle thresholds: 0.125 inches minimum thickness.
3. Exteriors: Seal perimeter to exclude water and vermin. Use sealant complying with requirements in Division 7 "Thermal and Moisture Protection". Minimum 0.25 inch diameter fasteners and lead expansion shield anchors, or Red-Head #SFS-1420 (or approved equivalent) Flat Head Sleeve Anchors. National Guard Products' "COMBO" or Pemko Manufacturing's "FHSL".
4. Plastic plugs with wood or sheet metal screws are not an acceptable substitute for specified fastening methods.
5. Fasteners: Generally, exposed screws to be Phillips or Robertson drive. Pinned TORX drive at high security areas. Flat head sleeve anchors (FHSL) may be slotted drive. Sheet metal and wood screws: full-thread. Sleeve nuts: full length to prevent door compression.

F. Through-bolts: Do not use. Coordinate with wood doors; ensure provision of proper blocking to support wood screws for mounting panic hardware and door closers. Coordinate with metal doors and frames; ensure provision of proper reinforcement to support machine screws for mounting panic hardware and door closers.

1. Exception: surface-mounted overhead stops, holders, and friction stays.

G. Silencers: Interior hollow metal frames, 3 for single doors, 4 for pairs of doors. Leave no unfilled/uncovered pre-punched silencer holes. Intent: door bears against silencers, seals make minimal contact with minimal compression – only enough to effect a seal. Provide where seals are not used

H. Wall- & Floor-mounted electromagnetic door holders: LCN's SEM series or approved equivalent. Incorporate into U.L. listed fire & life-safety system, doors release to allow closure and latching when door's zone is in alarm state. Use minimum projection required to allow door to open as widely as allowed by wall conditions and projection of door hardware.

2.8 FINISH:

1. Generally: BHMA 626 Satin Chromium Areas using BHMA 626: furnish push-plates, pulls and protection plates of BHMA 630, Satin Stainless Steel, unless otherwise scheduled.

I. Door closers: factory powder coated to match other hardware, unless otherwise noted.

2.9 KEYING REQUIREMENTS:

A. Key System: Existing Corbin Russwin system. Meet with owner for keying instructions

B. Keys

2. Factory registered master key system
3. Non-I.C. construction keying: furnish inserted type partial key. At substantial completion, remove inserts in Owner's presence; demonstrate consequent non-operability of construction key. Give all removed inserts and all construction keys to Owner, provide accounting for all the pieces.
4. Temporary cylinders/cores remain supplier's property.
5. Furnish 10 construction keys.

C. Key Cylinders: furnish, 6-pin solid brass construction.

D. Cylinders/Cylinder cores: furnish keyed at factory of lock manufacturer where permanent records are maintained. Locks and cylinders same manufacturer.

E. Permanent keys: furnish secured shipment direct from point of origination to Owner.

6. For estimate: 3 keys per change combination, 5 master keys per group, 5 grand-master keys, 3 control keys.
7. For estimate: "DO NOT DUPLICATE".

F. Bitting List: furnish secured shipment direct from point of origination to Owner upon completion.

PART 3 - EXECUTION

3.1 ACCEPTABLE INSTALLERS:

A. Can read and understand manufacturers' templates, suppliers' hardware schedule and printed installation instructions. Can readily distinguish drywall screws from manufacturers' furnished fasteners. Available to meet with manufacturers' representatives and related trades to discuss installation of hardware.

3.2 PREPARATION:

A. Ensure that walls and frames are square and plumb before hardware installation. Make corrections before commencing hardware installation. Installation denotes acceptance of wall/frame condition.

B. Locate hardware per SDI-100 and applicable building, fire, life-safety, accessibility, and security codes.

1. Notify Architect of code conflicts before ordering material.
2. Locate latching hardware between 34 inches to 44 inches above the finished floor, per California Building Code, Section 1010.1.9.2 and 11B-404.2.7.

3. Locate panic hardware between 36 inches to 44 inches above the finished floor.
4. Where new hardware is to be installed near existing doors/hardware scheduled to remain, match locations of existing hardware.

C. Overhead stops: before installing, determine proposed locations of furniture items, fixtures, and other items to be protected by the overhead stop's action.

3.3 INSTALLATION

A. Install hardware per manufacturer's instructions and recommendations. Do not install surface-mounted items until finishes have been completed on substrate. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate for proper installation and operation. Remove and reinstall or replace work deemed defective by Architect.

1. Gaskets: install jamb-applied gaskets before closers, overhead stops, rim strikes, etc; fasten hardware over and through these seals. Install sweeps across bottoms of doors before astragals, cope sweeps around bottom pivots, trim astragals to tops of sweeps.
2. When hardware is to be attached to existing metal surface and insufficient reinforcement exists, use RivNuts, NutSerts or similar anchoring device for screws.
3. Use manufacturers' fasteners furnished with hardware items, or submit Request for Substitution with Architect.
4. Replace fasteners damaged by power-driven tools.

B. Locate floor stops no more that 4 inches from walls and not within paths of travel. See paragraph 2.2 regarding hinge widths, door should be well clear of point of wall reveal. Point of door contact no closer to the hinge edge than half the door width. Where situation is questionable or difficult, contact Architect for direction.

C. Core concrete for exterior door stop anchors. Set anchors in approved non-shrink grout.

D. Locate overhead stops for minimum 90 degrees at rest and for maximum allowable degree of swing.

E. Drill pilot holes for fasteners in wood doors and/or frames.

F. Lubricate and adjust existing hardware scheduled to remain. Carefully remove and give to Owner items not scheduled for reuse.

3.4. ADJUSTING

A. Adjust and check for proper operation and function. Replace units, which cannot be adjusted to operate freely and smoothly.

1. Hardware damaged by improper installation or adjustment methods: repair or replace to Owner's satisfaction.
2. Adjust doors to fully latch with no more than 1 pound of pressure.

a) Door closer valves: turn valves clockwise until at bottom – do not force. Turn valves back out one and one-half turns and begin adjustment process from that point. Do not force valves beyond three full turns counterclockwise.

3. Adjust delayed-action closers on fire-rated doors to fully close from fully-opened position in no more than 10 seconds.
4. Adjust door closers per 1.9 this section.

B. Fire-rated doors:

1. Wood doors: adjust to 0.125 inches clearance at heads, jambs, and meeting stiles.
2. Steel doors: adjust to 0.063 inches minimum to 0.188 inches maximum clearance at heads, jambs, and meeting stiles.
3. Adjust wood and steel doors to 0.75 inches maximum clearance (undercut) above threshold or finish floor material under door.

C. Final inspection: Installer to provide letter to Owner that upon completion installer has visited the Project and has accomplished the following:

4. Has re-adjusted hardware.
5. Has evaluated maintenance procedures and recommend changes or additions, and instructed Owner's personnel.
6. Has identified items that have deteriorated or failed.
7. Has submitted written report identifying problems.

3.5 DEMONSTRATION:

D. Demonstrate mechanical hardware and electrical, electronic and pneumatic hardware systems, including adjustment and maintenance procedures.

3.6 PROTECTION/CLEANING:

A. Cover installed hardware, protect from paint, cleaning agents, weathering, carts/barrows, etc. Remove covering materials and clean hardware just prior to substantial completion.

B. Clean adjacent wall, frame and door surfaces soiled from installation / reinstallation process.

3.7 SCHEDULE OF FINISH HARDWARE

A. See door schedule in drawings for hardware set assignments.

HW SET: 010.2
DOOR NUMBER:
279B 279C 279D 379B 379C 379D

EACH TO HAVE:

3	EA	HINGE	3CB1 4.5 X 4.5	652	IVE
1	EA	LATCHSET	ML2010 - NSA	626	C-R
1	EA	DOME STOP	FS436/438 AS REQ'D	626	IVE
1	SET	PERIMETER SEAL	S88D HEAD AND JAMBS	BRN	PEM
1	EA	DOOR BOTTOM	367AA	CL	ZER
1	EA	THRESHOLD	AS DETAILED	AL	ZER

HW SET: 030.2
DOOR NUMBER:
118.1A

EACH TO HAVE:

3	EA	HINGE	3CB1 4.5 X 4.5	652	IVE
1	EA	OFFICE LOCK	ML2053 - NSA	630	C-R
1	EA	DOME STOP	FS436/438 AS REQ'D	626	IVE
1	SET	PERIMETER SEAL	S88D HEAD AND JAMBS	BRN	PEM
1	EA	DOOR BOTTOM	367AA	CL	ZER
1	EA	THRESHOLD	AS DETAILED	AL	ZER

HW SET: 051.2
DOOR NUMBER:
228B 328B

EACH TO HAVE:

3	EA	HINGE	3CB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	ML2057 - NSA	630	C-R
1	EA	OVERHEAD HOLDER	90H	630	GLY
3	EA	SILENCER	SR64	GRY	IVE

HW SET: 054
DOOR NUMBER:
209B 309B 409B

EACH TO HAVE:

3	EA	HINGE	3CB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	ML2057 - NSA	630	C-R
1	EA	CLOSER	4040XP-H	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	DOME STOP	FS436/438 AS REQ'D	626	IVE
3	EA	SILENCER	SR64	GRY	IVE

HW SET: 070.2AD
DOOR NUMBER:
128.1A

EACH TO HAVE:

2	EA	HINGE	3CB1 4.5 X 4.5	652	IVE
1	EA	ELECTRIC HINGE	3CB1 4.5 X 4.5 TW	652	IVE
1	EA	ELECTRONIC LOCK	AD-300-MS/MD-RHO-TD FOR REFERENCE ONLY	626	SCE
1	EA	CYLINDER	AS REQ'D	626	C-R
1	EA	DOME STOP	FS436/438 AS REQ'D	626	IVE
1	SET	PERIMETER SEAL	S88D HEAD AND JAMBS	BRN	PEM
1	EA	DOOR BOTTOM	367AA	CL	ZER
1	EA	THRESHOLD	AS DETAILED	AL	ZER

ELECTRIC LOCK SHOWN HERE FOR REFERENCE AND TEMPLATING ONLY. IT WILL BE SPECIFIED IN THE INTEGRATED SECURITY SYSTEMS SECTION WITH ALL COMPONENTS FOR A COMPLETE SECURITY SYSTEM

HW SET: 074.2AD
DOOR NUMBER:
101A 101B

EACH TO HAVE:

2	EA	HINGE	3CB1 4.5 X 4.5	652	IVE
1	EA	ELECTRIC HINGE	3CB1 4.5 X 4.5 TW	652	IVE
1	EA	ELECTRONIC LOCK	AD-300-MS/MD-RHO-TD FOR REFERENCE ONLY	626	SCE
1	EA	CYLINDER	AS REQ'D	626	C-R
1	EA	CLOSER	4040XP-H	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	DOME STOP	FS436/438 AS REQ'D	626	IVE
1	SET	PERIMETER SEAL	S88D HEAD AND JAMBS	BRN	PEM
1	EA	DOOR BOTTOM	367AA	CL	ZER
1	EA	THRESHOLD	AS DETAILED	AL	ZER

ELECTRIC LOCK SHOWN HERE FOR REFERENCE AND TEMPLATING ONLY. IT WILL BE SPECIFIED IN THE INTEGRATED SECURITY SYSTEMS SECTION WITH ALL COMPONENTS FOR A COMPLETE SECURITY SYSTEM

HW SET: 114.7
DOOR NUMBER:
200B 200C 300B 300C 400B 400C

EACH TO HAVE:

4	EA	HINGE	3CB1HW 4.5 X 4.5	652	IVE
1	EA	LATCHSET	ML2010 - NSA	626	C-R
1	EA	SURFACE CLOSER	4000T	689	LCN

1	EA	DOME STOP	FS436/438 AS REQ'D	626	IVE
1	EA	MAGNETIC HOLD-OPEN	SEM SERIES	AL	LCN
1	SET	PERIMETER SEALS	328AA HEAD AND JAMBS	AL	ZER
1	EA	AUTO DOOR BOTTOM	355A	AL	ZER
1	EA	THRESHOLD	AS DETAILED	AL	ZER

FIRE ALARM INTERTIE

HW SET: 122
DOOR NUMBER:
R171A

EACH TO HAVE:

3	EA	HINGE	3CB1 4.5 X 4.5	630	IVE
1	EA	PRIVACY W/INDICATOR	ML2030 - ML193-V20-NSA	630	C-R
1	EA	CLOSER	4040XP	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	MOP PLATE	8400 4" X 2" LDW	630	IVE
1	EA	WALL STOP	WS401CCV	626	IVE
1	SET	PERIMETER SEALS	188 HEAD AND JAMBS	BLK	ZER

HW SET: 122.5
DOOR NUMBER:
R171G

EACH TO HAVE:

3	EA	HINGE	5BB1HW 4.5 X 4.5	630	IVE
1	EA	PRIVACY W/INDICATOR	ML2030 - ML193-V20-NSA	630	C-R
1	EA	CLOSER	4040XP	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	MOP PLATE	8400 4" X 2" LDW	630	IVE
1	EA	WALL STOP	WS401CCV	626	IVE
1	SET	PERIMETER SEALS	188 HEAD AND JAMBS	BLK	ZER

HW SET: 122S
DOOR NUMBER:

R110A	R110B	R110C	R163A	R163C	R163G
R171C	R210A	R210C	R216A	R216C	R263A
R263C	R271A	R271C	R310A	R310C	R316A
R316C	R363A	R363C	R371A	R371C	R410A
R410C	R416A	R416C			

EACH TO HAVE:

3	EA	HINGE	3CB1 4.5 X 4.5	630	IVE
1	EA	PRIVACY W/INDICATOR	ML2030 - ML193-V20-NSA	630	C-R
1	EA	CLOSER	1461 FC	689	LCN

1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	MOP PLATE	8400 4" X 2" LDW	630	IVE
1	EA	WALL STOP	WS401CCV	626	IVE
1	SET	PERIMETER SEALS	188 HEAD AND JAMBS	BLK	ZER

HW SET: 123S
DOOR NUMBER:

R163B	R163D	R163E	R163F	R171B	R171D
R171E	R171F	R210B	R210D	R210E	R210F
R210G	R216B	R216D	R216E	R216F	R216G
R263B	R263D	R263E	R263F	R263G	R271B
R271D	R271E	R271F	R271G	R310B	R310D
R310E	R310F	R310G	R316B	R316D	R316E
R316F	R316G	R363B	R363D	R363E	R363F
R363G	R371B	R371D	R371E	R371F	R371G
R410B	R410D	R410E	R410F	R410G	R416B
R416D	R416E	R416F	R416G		

EACH TO HAVE:

3	EA	HINGE	3CB1 4.5 X 4.5	630	IVE
1	EA	PRIVACY W/INDICATOR	ML2030 - ML193-V20-NSA	630	C-R
1	EA	CLOSER	1461-SCNS FC	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	SET	PERIMETER SEALS	188 HEAD AND JAMBS	BLK	ZER

HW SET: 152
DOOR NUMBER:

107B	112D	207B	307B	407B

EACH TO HAVE:

3	EA	HINGE	3CB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	ML2057 - NSA	630	C-R
1	EA	CLOSER	4040XP	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	DOME STOP	FS436/438 AS REQ'D	626	IVE
1	SET	PERIMETER SEALS	328AA HEAD AND JAMBS	AL	ZER

HW SET: 153
DOOR NUMBER:
112B

EACH TO HAVE:

3	EA	HINGE	3CB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	ML2057 - NSA	630	C-R

1	EA	CLOSER	4040XP S-CUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	SET	PERIMETER SEALS	328AA HEAD AND JAMBS	AL	ZER

HW SET: 172.2AD
DOOR NUMBER:

101C	101D	109A	118A	120A	128B
228A	328A	428A			

EACH TO HAVE:

2	EA	HINGE	3CB1 4.5 X 4.5	652	IVE
1	EA	ELECTRIC HINGE	3CB1 4.5 X 4.5 TW	652	IVE
1	EA	ELECTRONIC LOCK	AD-300-MS/MD-RHO-TD FOR REFERENCE ONLY	626	SCE
1	EA	CYLINDER	AS REQ'D	626	C-R
1	EA	CLOSER	4040XP	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	DOME STOP	FS436/438 AS REQ'D	626	IVE
1	SET	PERIMETER SEAL	S88D HEAD AND JAMBS	BRN	PEM
1	EA	DOOR BOTTOM	367AA	CL	ZER
1	EA	THRESHOLD	AS DETAILED	AL	ZER

ELECTRIC LOCK SHOWN HERE FOR REFERENCE AND TEMPLATING ONLY. IT WILL BE SPECIFIED IN THE INTEGRATED SECURITY SYSTEMS SECTION WITH ALL COMPONENTS FOR A COMPLETE SECURITY SYSTEM

HW SET: 172AD
DOOR NUMBER:

107A	108A	113A	115A	117A	121.1A
129B	152A	153A	154A	156A	158A
160A	162A	164A	165A	166A	167A
168A	169A	170A	172A	173A	174A
175A	176A	177A	178A	180A	202A
203A	205A	207A	209A	211A	212A
213A	214A	215A	217A	218A	219A
221A	222A	223A	225A	227A	229A
252A	253A	254A	256A	258A	260A
262A	264A	265A	266A	267A	268A
269A	270A	272A	273A	274A	275A
276A	277A	278A	280A	302A	303A
305A	307A	309A	311A	312A	313A
314A	315A	317A	318A	319A	321A
322A	323A	325A	327A	329A	352A
353A	354A	356A	358A	360A	362A
364A	365A	366A	367A	368A	370A
372A	373A	374A	375A	376A	377A
378A	380A	402A	403A	405A	407A

409A	411A	412A	413A	414A	415A
417A	418A	419A	421A	422A	423A
425A	427A	429A			

EACH TO HAVE:

2	EA	HINGE	3CB1 4.5 X 4.5	652	IVE
1	EA	ELECTRIC HINGE	3CB1 4.5 X 4.5 TW	652	IVE
1	EA	ELECTRONIC LOCK	AD-300-MS/MD-RHO-TD FOR REFERENCE ONLY	626	SCE
1	EA	CYLINDER	AS REQ'D	626	C-R
1	EA	CLOSER	1461 FC	689	LCN
1	EA	WALL STOP	WS401CCV	626	IVE
1	SET	PERIMETER SEALS	328AA HEAD AND JAMBS	AL	ZER
1	EA	AUTO DOOR BOTTOM	360	AL	ZER
1		THRESHOLD	BY OTHERS		B/O

ELECTRIC LOCK SHOWN HERE FOR REFERENCE AND TEMPLATING ONLY. IT WILL BE SPECIFIED IN THE INTEGRATED SECURITY SYSTEMS SECTION WITH ALL COMPONENTS FOR A COMPLETE SECURITY SYSTEM

HW SET: 182
DOOR NUMBER:

S1A	S1C	S1D	S1E	S3A	S3C
S3D	S4A	S4C	S4D		

EACH TO HAVE:

3	EA	HINGE	3CB1 4.5 X 4.5	652	IVE
1	EA	FIRE EXIT DEVICE	AX-98-L-F-996L-06	626	VON
1	EA	RIM CYLINDER	3000	626	C-R
1	EA	CLOSER	4040XP	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	DOME STOP	FS436/438 AS REQ'D	626	IVE
1	SET	PERIMETER SEALS	328AA HEAD AND JAMBS	AL	ZER

HW SET: 182.7
DOOR NUMBER:

S2A	S2C	S2D	S2E

EACH TO HAVE:

4	EA	HINGE	3CB1 4.5 X 4.5	652	IVE
1	EA	FIRE EXIT DEVICE	AX-98-L-F-996L-06	626	VON
1	EA	RIM CYLINDER	3000	626	C-R
1	EA	CLOSER	4040XP	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	DOME STOP	FS436/438 AS REQ'D	626	IVE
1	SET	PERIMETER SEALS	328AA HEAD AND JAMBS	AL	ZER

HW SET: 192
DOOR NUMBER:
119B

EACH TO HAVE:

3	EA	HINGE	3CB1 4.5 X 4.5	652	IVE
1	EA	POWER TRANSFER	EPT-10	689	VON
1	EA	ELECTRIC FIRE EXIT DEVICE	QELX-RX-98-L-F-996L-06	626	VON
1	EA	RIM CYLINDER	3000	626	C-R
1	EA	CLOSER	4040XP	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	DOME STOP	FS436/438 AS REQ'D	626	IVE
1	SET	PERIMETER SEALS	328AA HEAD AND JAMBS	AL	ZER
1	EA	POWER SUPPLY	PS904 X 900-2RS X 900-FA		VON

CARD READER AND WIRING BY OTHERS

HW SET: 372AD
DOOR NUMBER:
100D

EACH TO HAVE:

5	EA	HINGE	3CB1 4.5 X 4.5	652	IVE
1	EA	ELECTRIC HINGE	3CB1 4.5 X 4.5 TW	652	IVE
1	SET	AUTO FLUSH BOLT	FB31/41 AS REQ'D	626	IVE
1	EA	DUST PROOF STRIKE	DP1/2 AS REQ'D	626	IVE
1	EA	ELECTRONIC LOCK	AD-300-MS/MD-RHO-TD FOR REFERENCE ONLY	626	SCE
1	EA	CYLINDER	AS REQ'D	626	C-R
1	EA	COORDINATOR	COR2-COMPLETE	628	IVE
2	EA	CLOSER	4040XP	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW	630	IVE
2	EA	DOME STOP	FS436/438 AS REQ'D	626	IVE
1	SET	PERIMETER SEALS	328AA HEAD AND JAMBS	AL	ZER
1	EA	ASTRAGAL	44STST X 188	600	ZER

ELECTRIC LOCK SHOWN HERE FOR REFERENCE AND TEMPLATING ONLY. IT WILL BE SPECIFIED IN THE INTEGRATED SECURITY SYSTEMS SECTION WITH ALL COMPONENTS FOR A COMPLETE SECURITY SYSTEM

HW SET: 373AD
DOOR NUMBER:
151A 251A 351A

EACH TO HAVE:

5	EA	HINGE	3CB1 4.5 X 4.5	652	IVE
1	EA	ELECTRIC HINGE	3CB1 4.5 X 4.5 TW	652	IVE
1	SET	AUTO FLUSH BOLT	FB31/41 AS REQ'D	626	IVE
1	EA	DUST PROOF STRIKE	DP1/2 AS REQ'D	626	IVE
1	EA	ELECTRONIC LOCK	AD-300-MS/MD-RHO-TD FOR REFERENCE ONLY	626	SCE
1	EA	CYLINDER	AS REQ'D	626	C-R
1	EA	COORDINATOR	COR2-COMPLETE	628	IVE
2	EA	CLOSER	4040XP S-CUSH	689	LCN
1	SET	PERIMETER SEALS	328AA HEAD AND JAMBS	AL	ZER
1	EA	ASTRAGAL	44STST X 188	600	ZER

ELECTRIC LOCK SHOWN HERE FOR REFERENCE AND TEMPLATING ONLY. IT WILL BE SPECIFIED IN THE INTEGRATED SECURITY SYSTEMS SECTION WITH ALL COMPONENTS FOR A COMPLETE SECURITY SYSTEM

HW SET: 384I
DOOR NUMBER:
200A 200D 300A 300D 400A

EACH TO HAVE:

6	EA	HINGE	3CB1HW 4.5 X 4.5	652	IVE
2	EA	IMPACT FIRE EXIT DEVICE	9447-L-F-996L-06-LBR	626	VON
2	EA	MORTISE CYLINDER	1000	626	C-R
2	EA	CLOSER	4040XP	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW	630	IVE
2	EA	DOME STOP	FS436/438 AS REQ'D	626	IVE
2	EA	MAGNETIC HOLD-OPEN	SEM SERIES	AL	LCN
1	SET	PERIMETER SEALS	328AA HEAD AND JAMBS	AL	ZER
1	SET	MEETING ASTRAGAL	328AA	628	ZER

SPECIAL PREP REQUIRED IN HOLLOW METAL DOOR

HW SET: 452
DOOR NUMBER:
401B

EACH TO HAVE:

3	EA	HINGE	3CB1 4.5 X 4.5 NRP SEC STUD	630	IVE
1	EA	STOREROOM LOCK	ML2057 - NSA	630	C-R
1	EA	CLOSER	4040XP S-CUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	SET	PERIMETER SEALS	328AA HEAD AND JAMBS	AL	ZER
1	EA	AUTO DOOR BOTTOM	355A	AL	ZER
1	EA	THRESHOLD	AS DETAILED	AL	ZER

HW SET: 473AD
DOOR NUMBER:
121.2A

EACH TO HAVE:

2	EA	HINGE	3CB1 4.5 X 4.5 NRP SEC STUD	630	IVE
1	EA	ELECTRIC HINGE	3CB1 4.5 X 4.5 TW	630	IVE
1	EA	ELECTRONIC LOCK	AD-300-MS/MD-RHO-TD FOR REFERENCE ONLY	626	SCE
1	EA	CYLINDER	AS REQ'D	626	C-R
1	EA	CLOSER	4040XP S-CUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	SET	PERIMETER SEALS	328AA HEAD AND JAMBS	AL	ZER
1	EA	AUTO DOOR BOTTOM	355A	AL	ZER
1	EA	THRESHOLD	AS DETAILED	AL	ZER

ELECTRIC LOCK SHOWN HERE FOR REFERENCE AND TEMPLATING ONLY. IT WILL BE SPECIFIED IN THE INTEGRATED SECURITY SYSTEMS SECTION WITH ALL COMPONENTS FOR A COMPLETE SECURITY SYSTEM

HW SET: 475AD
DOOR NUMBER:
129A

EACH TO HAVE:

2	EA	HINGE	3CB1 4.5 X 4.5	630	IVE
1	EA	ELECTRIC HINGE	3CB1 4.5 X 4.5 TW	630	IVE
1	EA	ELECTRONIC LOCK	AD-300-MS/MD-RHO-TD FOR REFERENCE ONLY	626	SCE
1	EA	CYLINDER	AS REQ'D	626	C-R
1	EA	CLOSER	4040XP	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	WALL STOP	WS401CCV	626	IVE
1	SET	PERIMETER SEALS	328AA HEAD AND JAMBS	AL	ZER
1	EA	AUTO DOOR BOTTOM	355A	AL	ZER
1	EA	THRESHOLD	AS DETAILED	AL	ZER

ELECTRIC LOCK SHOWN HERE FOR REFERENCE AND TEMPLATING ONLY. IT WILL BE SPECIFIED IN THE INTEGRATED SECURITY SYSTEMS SECTION WITH ALL COMPONENTS FOR A COMPLETE SECURITY SYSTEM

HW SET: 480
DOOR NUMBER:
S2B S4B

EACH TO HAVE:

3	EA	HINGE	3CB1 4.5 X 4.5 NRP SEC STUD	630	IVE
1	EA	EXIT DEVICE	AX-98-EO	626	VON

1	EA	ALARM KIT	98-ALK LX	628	VON
1	EA	MORTISE CYLINDER	1000 FOR ALARM RESET	626	C-R
1	EA	CLOSER	4040XP EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	FLOOR STOP	FS441/442 AS REQUIRED	626	IVE
1	SET	PERIMETER SEALS	328AA HEAD AND JAMBS	AL	ZER
1	EA	AUTO DOOR BOTTOM	355A	AL	ZER
1	EA	THRESHOLD	AS DETAILED	AL	ZER

HW SET: 480.3
DOOR NUMBER:
S1B S3B

EACH TO HAVE:

3	EA	HINGE	3CB1 4.5 X 4.5 NRP SEC STUD	630	IVE
1	EA	EXIT DEVICE	AX-98-EO	626	VON
1	EA	ALARM KIT	98-ALK LX	628	VON
1	EA	MORTISE CYLINDER	1000 FOR ALARM RESET	626	C-R
1	EA	CLOSER	4040XP S-CUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	SET	PERIMETER SEALS	328AA HEAD AND JAMBS	AL	ZER
1	EA	AUTO DOOR BOTTOM	355A	AL	ZER
1	EA	THRESHOLD	AS DETAILED	AL	ZER

HW SET: 652
DOOR NUMBER:
501A 501E

EACH TO HAVE:

3	EA	HINGE	3CB1 4.5 X 4.5 NRP SEC STUD	630	IVE
1	EA	STOREROOM LOCK	ML2057 - NSA	630	C-R
1	EA	CLOSER	4040XP EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	FLOOR STOP	FS441/442 AS REQUIRED	626	IVE
1	SET	PERIMETER SEALS	328AA HEAD AND JAMBS	AL	ZER
1	EA	AUTO DOOR BOTTOM	355A	AL	ZER
1	EA	THRESHOLD	AS DETAILED	AL	ZER

HW SET: 696.5
DOOR NUMBER:
119A

EACH TO HAVE:

3	EA	HINGE	3CB1HW 4.5 X 4.5 NRP SEC STUD	630	IVE

1	EA	POWER TRANSFER	EPT-10	689	VON
1	EA	ELECTRIC EXIT DEVICE	QELX-RX-98-L-NL-996L-06	626	VON
1	EA	RIM CYLINDER	3000	626	C-R
1	EA	CLOSER	4040XP S-CUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	SET	PERIMETER SEALS	328AA HEAD AND JAMBS	AL	ZER
1	EA	AUTO DOOR BOTTOM	355A	AL	ZER
1	EA	THRESHOLD	AS DETAILED	AL	ZER
1	EA	POWER SUPPLY	PS904 X 900-2RS		VON

CARD READER AND WIRING BY OTHERS

HW SET: 960
DOOR NUMBER:
109B

EACH TO HAVE:

	ALL HARDWARE BY ROLL UP DOOR MANUFACTURER	B/O

HW SET: 962
DOOR NUMBER:
100C

EACH TO HAVE:

	ALL HARDWARE BY SLIDING DOOR MANUFACTURER	B/O

HW SET: 970
DOOR NUMBER:
501C 501D

EACH TO HAVE:

	ALL HARDWARE BY GATE MANUFACTURER	B/O

HW SET: 972
DOOR NUMBER:
G1

EACH TO HAVE:

1	EA	STOREROOM LOCK	L9080T 06A	630	SCH
1	EA	CYLINDER	AS REQ'D	630	C-R
1	EA	ELECTRIC STRIKE	6211	630	VON

1	EA	POWER SUPPLY	PS902 X 900-2RS BALANCE OF HARDWARE BY GATE MANUFACTURER	GRY	VON B/O

POWER SUPPLY MUST BE MOUNTED IN A DRY AREA. ELECTRIC STRIKE MUST BE SEALED IN THE FRAME

HW SET: 975
DOOR NUMBER:
G2

EACH TO HAVE:

1	EA	STOREROOM LOCK	L9080T 06A	630	SCH
1	EA	ELECTRIC STRIKE	6211	630	VON
1	EA	DOOR LOOP KIT	4840-459	689	LCN
1	EA	POWER SUPPLY	PS902 X 900-2RS BALANCE OF HARDWARE BY GATE MANUFACTURER	GRY	VON B/O

POWER SUPPLY MUST BE MOUNTED IN A DRY AREA. ELECTRIC STRIKE MUST BE SEALED IN THE FRAME

HW SET: A112.2
DOOR NUMBER:
279A 379A

EACH TO HAVE:

1	EA	PIVOT SET	7215	626	IVE
2	EA	INTERMEDIATE PIVOT	7215 INT	626	IVE
1	EA	LATCHSET	ML2010 - NSA	626	C-R
1	EA	CLOSER	4040XP	689	LCN
1	EA	MOUNTING PLATE	4040-18	689	LCN
1	EA	DOME STOP	FS436/438 AS REQ'D	626	IVE
1	SET	PERIMETER SEAL	S88D HEAD AND JAMBS	BRN	PEM
1	EA	AUTO DOOR BOTTOM	355A	AL	ZER
1	EA	THRESHOLD	AS DETAILED	AL	ZER

CARD READER AND WIRING BY OTHERS
DOOR MUST BE WIDE STILE TO MOUNT LOCK

HW SET: A172.2AD
DOOR NUMBER:
112C 179B

EACH TO HAVE:

1	EA	PIVOT SET	7215	626	IVE
1	EA	INTERMEDIATE PIVOT	7215 INT	626	IVE
1	EA	POWER TRANSF PIVOT	7215PT INT	626	IVE
1	EA	ELECTRONIC LOCK	AD-300-MS/MD-RHO-TD FOR REFERENCE ONLY	626	SCE
1	EA	CYLINDER	AS REQ'D	626	C-R
1	EA	CLOSER	4040XP	689	LCN
1	EA	MOUNTING PLATE	4040-18	689	LCN
1	EA	OVERHEAD STOP	90S	626	GLY
1	SET	PERIMETER SEAL	S88D HEAD AND JAMBS	BRN	PEM
1	EA	DOOR SWEEP	339AA	AL	ZER
1	EA	THRESHOLD	AS DETAILED	AL	ZER

ELECTRIC LOCK SHOWN HERE FOR REFERENCE AND TEMPLATING ONLY. IT WILL BE SPECIFIED IN THE INTEGRATED SECURITY SYSTEMS SECTION WITH ALL COMPONENTS FOR A COMPLETE SECURITY SYSTEM
DOOR MUST BE WIDE STILE TO MOUNT LOCK

HW SET: A472.5AD
DOOR NUMBER:
179C

EACH TO HAVE:

1	EA	PIVOT SET	7215	626	IVE
1	EA	INTERMEDIATE PIVOT	7215 INT	626	IVE
1	EA	POWER TRANSF PIVOT	7215PT INT	626	IVE
1	EA	ELECTRONIC LOCK	AD-300-MS/MD-RHO-TD FOR REFERENCE ONLY	626	SCE
1	EA	CYLINDER	AS REQ'D	626	C-R
1	EA	CLOSER	4040XP EDA	689	LCN
1	EA	MOUNTING PLATE	4040-18	689	LCN
1	EA	FLOOR STOP	FS441/442 AS REQUIRED	626	IVE
1	EA	THRESHOLD	AS DETAILED	AL	ZER

SEALS AND SWEEPS BY DOOR MANUFACTURER
INTEGRATED SECURITY SYSTEMS SECTION WITH ALL COMPONENTS FOR A COMPLETE SECURITY SYSTEM
DOORS MUST BE WIDE STILE TO MOUNT LOCK

HW SET: A472.7AD
DOOR NUMBER:
112A 128A

EACH TO HAVE:

1	EA	PIVOT SET	7215	626	IVE
1	EA	INTERMEDIATE PIVOT	7215 INT	626	IVE
1	EA	POWER TRANSF PIVOT	7215PT INT	626	IVE
1	EA	ELECTRONIC LOCK	AD-300-MS/MD-RHO-TD FOR REFERENCE ONLY	626	SCE

1	EA	CYLINDER	AS REQ'D	626	C-R
1	EA	CLOSER	4040XP EDA	689	LCN
1	EA	MOUNTING PLATE	4040-18	689	LCN
1	EA	FLOOR STOP	FS441/442 AS REQUIRED	626	IVE
1	EA	THRESHOLD	AS DETAILED	AL	ZER

SEALS AND SWEEPS BY DOOR MANUFACTURER
INTEGRATED SECURITY SYSTEMS SECTION WITH ALL COMPONENTS FOR A COMPLETE SECURITY SYSTEM

HW SET: A492.7
DOOR NUMBER:
100G

EACH TO HAVE:

1	EA	PIVOT SET	7215	626	IVE
1	EA	INTERMEDIATE PIVOT	7215 INT	626	IVE
1	EA	POWER TRANSFER	EPT-10	689	VON
1	EA	ELECTRIC EXIT DEVICE	QELX-RX-98-NL/OP	626	VON
1	EA	RIM CYLINDER	3000	626	C-R
1	EA	OFFSET DOOR PULL	8190-0 10" CTOC	630	IVE
1	EA	CLOSER	4040XP EDA	689	LCN
1	EA	MOUNTING PLATE	4040-18	689	LCN
1	EA	FLOOR STOP	FS441/442 AS REQUIRED	626	IVE
1	EA	THRESHOLD	AS DETAILED	AL	ZER
1	EA	POWER SUPPLY	PS904 X 900-2RS		VON

SEALS AND SWEEPS BY DOOR MANUFACTURER
DOORS MUST BE WIDE STILE TO MOUNT PANIC HARDWARE
CARD READER AND WIRING BY OTHERS

HW SET: A499.7
DOOR NUMBER:
100B

EACH TO HAVE:

1	EA	CONTINUOUS HINGE	224XY EPT	628	IVE
1	EA	POWER TRANSFER	EPT-10	689	VON
1	EA	ELECTRIC EXIT DEVICE	QELX-RX-98-NL/OP	626	VON
1	EA	MORTISE CYLINDER	1000 FOR KEYSWITCH	626	C-R
1	EA	RIM CYLINDER	3000	626	C-R
1	EA	OFFSET DOOR PULL	8190-0 10" CTOC	630	IVE
2	EA	BOLLARD/ACTUATOR FULL	8310-3836T		LCN
1	EA	AUTO. OPERATOR	9540 SERIES	628	LCN
1	EA	FLOOR STOP	FS441/442 AS REQUIRED	626	IVE
1	EA	THRESHOLD	AS DETAILED	AL	ZER

1	EA	POWER SUPPLY	PS906 X 900-4RL X FA X 900-BBK	GRY	VON
1	EA	KEYSWITCH	650 SERIES X L2	630	SCE

SEALS AND SWEEPS BY DOOR MANUFACTURER
DOORS MUST BE WIDE STILE TO MOUNT PANIC HARDWARE
CARD READER AND WIRING BY OTHERS

HW SET: A599R.7
DOOR NUMBER:
100A

EACH TO HAVE:

2	EA	CONTINUOUS HINGE	224XY EPT	628	IVE
2	EA	POWER TRANSFER	EPT-10	689	VON
1	EA	MULLION	5654	628	VON
1	EA	ELECTRIC EXIT DEVICE	QELX-RX-98-EO	626	VON
1	EA	ELECTRIC EXIT DEVICE	QELX-RX-98-NL/OP	626	VON
1	EA	MORTISE CYLINDER	1000 FOR KEYSWITCH	626	C-R
1	EA	RIM CYLINDER	3000	626	C-R
2	EA	OFFSET DOOR PULL	8190-0 10" CTOC	630	IVE
2	EA	BOLLARD/ACTUATOR FULL	8310-3836T		LCN
1	EA	AUTO. OPERATOR	9550 SERIES	628	LCN
2	EA	FLOOR STOP	FS441/442 AS REQUIRED	626	IVE
1	EA	THRESHOLD	AS DETAILED	AL	ZER
1	EA	POWER SUPPLY	PS906 X 900-4RL X FA X 900-BBK	GRY	VON
1	EA	KEYSWITCH	650 SERIES X L2	630	SCE

SEALS AND SWEEPS BY DOOR MANUFACTURER
CARD READER AND WIRING BY OTHERS
DOORS MUST BE WIDE STILE TO MOUNT PANICS

HW SET: U010
DOOR NUMBER:
129C 129E

EACH TO HAVE:

3	EA	HINGE	3CB1 4.5 X 4.5	652	IVE
1	EA	LATCHSET	ML2010 - NSA	626	C-R
1	EA	WALL STOP	WS401CCV	626	IVE
3	EA	SILENCER	SR64	GRY	IVE

HW SET: U020
DOOR NUMBER:
129D

EACH TO HAVE:

3	EA	HINGE	3CB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY W/INDICATOR	ML2030 - ML193-V20-NSA	626	C-R
1	EA	WALL STOP	WS401CCV	626	IVE
3	EA	SILENCER	SR64	GRY	IVE

HW SET: U959
DOOR NUMBER:
129F 129G 129J

EACH TO HAVE:

1	SET	BP TRACK AND HDWE	134F**2D (1 3/4" DRS)	JOH

SIZE AS SCHEDULED

HW SET: U964
DOOR NUMBER:
129H

EACH TO HAVE:

			ALL HARDWARE BY BI-FOLD DOOR MANUFACTURER	B/O

END OF SECTION

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Glass for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section.
   1. Doors.
   2. Curtainwall framing.
   3. Storefront framing.
   4. Multipanel bifold aluminum-framed glass doors.
   5. Fiberglass windows.

B. Related Sections:
   1. Section 083518 "Multipanel Bifold Aluminum-Framed Glass Doors."
   2. Section 084113 "Aluminum-Framed Entrances and Storefronts."
   3. Section 084413 "Glazed Aluminum Curtain Walls."
      a. See section for spandrel metal and glass panels.
   4. Section 085413 "Fiberglass Windows."
   5. Section 088700 "Glazing Surface Films."
   6. Section 088813 "Fire-Rated Glazing."

1.2 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:
   1. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

C. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.

D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

E. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Preconstruction Test Reports: Preconstruction adhesion and compatibility test report.

B. Argon Gas Infill Compliance Certificate: IGCC/IGMA argon fill certification program certificates.

C. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

A. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.

B. Argon Gas Filled Insulating-Glass Testing Program: Fabricator shall employ non-destructive argon measuring equipment such as GasGlass by Sparklike Ltd to ensure that argon gas filled insulating glass units consistently pass IGCC/IGMA criteria for their argon fill certification programs.

1.6 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.

1.7 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 for 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazing.

C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the International Building Code and ASTM E1300.
1. Design Wind Pressures: As indicated on Drawings.
2. Thickness of Patterned Glass: Base design of patterned glass on thickness at thinnest part of the glass.
3. 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.
4. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

D. Safety Glazing: Provide safety glazing that complies with 16 CFR 1201, Category II in locations indicated, and where subject to human impact in accordance with Building Code requirements.

E. 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 of thickness indicated.
2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
3. 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.
   a. Maximum 0.30.
4. 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.
   a. South and west-facing windows: maximum SHGC of 0.25.
   b. North and east-facing windows: maximum SHGC of 0.64.
5. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

F. Sustainable Design Performance Requirements:
1. Sealants shall comply with the following:
   a. Low-Emitting Materials: Testing and product requirements of the California Department of Health Services CDPH Standard Method v1.1, using CA Section 01350, Appendix B, New Single-Family Residence Scenario.

2.2 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
   1. GANA Publications: "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 or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

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.

E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.3 GLASS PRODUCTS

A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.

B. Heat-Treated Float Glass: ASTM C1048, Kind FT (fully tempered) or Kind HS (heat strengthened) as indicated, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
   1. Bow and Warpage Tolerance: 25 percent less than ASTM C 1048.
   2. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

2.4 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E2190.
   1. Sealing System: Dual seals.
   2. Spacer: Polypropylene-covered stainless steel in color selected by Architect.
   3. Argon Gas Filled Units: Listed in the IGCC/IGMA Certified Products Directory designated "GCIA" for "Gas Content, Initial and After Weathering."

2.5 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
   1. EPDM complying with ASTM C 864.
   2. Silicone complying with ASTM C 1115.
   3. Thermoplastic polyolefin rubber complying with ASTM C 1115.

B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned 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.

2.6 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. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Glazing Sealant:
   1. Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 100/50, Use NT.

2.7 MISCELLANEOUS GLAZING MATERIALS

A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

B. Setting Blocks: Elastomeric material with a Shore A durometer hardness of 85, plus or minus 5.

C. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

D. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

E. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.8 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.

PART 3 - EXECUTION

3.1 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. 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.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than 50 inches.

G. 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.

3.2 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.

3.3 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.

3.4 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.

3.5 INTERIOR GLASS SCHEDULE

A. GLI-1: Clear fully tempered float glass.
   1. Overall Unit Thickness: 1 inch.
   2. Minimum Thickness of Each Glass Lite: 6 mm.
   3. Safety glazing.

B. GLI-2: Clear insulating glass.
   1. Overall Unit Thickness: 1 inch.

2. Minimum Thickness of Each Glass Lite: 6 mm.

C. GLI-3: Fire-rated glazing
1. Refer to Section 088813 "Fire-Rated Glazing"

D. GLI-4: Fire-rated glazing
1. Refer to Section 088813 "Fire-Rated Glazing"

3.6 EXTERIOR GLASS SCHEDULE

A. GL-1: Fully tempered, low-E-coated, clear insulating glass.
1. Overall Unit Thickness: 1 inch.
2. Minimum Thickness of Each Glass Lite: 6 mm.
3. Outdoor Lite: Heat-strengthened float glass.
4. Interspace Content: Argon.
5. Spacer: Warm edge spacer.
6. Indoor Lite: Heat-strengthened float glass.
7. Low-E Coating: Sputtered on second surface.
a. Product: Vitro Architectural Glass; Solarban 60.
8. Safety glazing.

B. GL-2: Low-E-coated, clear insulating glass.
1. Overall Unit Thickness: 1 inch.
2. Minimum Thickness of Each Glass Lite: 6 mm.
3. Outdoor Lite: Heat-strengthened float glass.
4. Interspace Content: Argon.
5. Spacer: Warm edge spacer.
6. Indoor Lite: Heat-strengthened float glass.
7. Low-E Coating: Sputtered on second surface.
a. Product: Vitro Architectural Glass; Solarban 60.
b. Applied to windows to meet SHGC performance goals by window orientation.

3.7 SPANDREL PANELS

1. Refer to Section 084413 "Glazed Aluminum Curtain Walls."

END OF SECTION

SECTION 088300 - MIRRORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following types of silvered flat glass mirrors:
   1. Annealed monolithic glass mirrors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:
   1. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachment details.

D. Samples: For each type of the following:
   1. Mirrors: 12 inches square, including edge treatment on two adjoining edges.
   2. Mirror Clips: Full size.
   3. Mirror Trim: 12 inches long.

1.3 INFORMATIONAL SUBMITTALS

A. Preconstruction Test Reports: From mirror manufacturer indicating that mirror mastic was tested for compatibility and adhesion with mirror backing and substrates on which mirrors are installed.

B. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For mirrors to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Glazing Publications: Comply with GANA's "Glazing Manual" and "Mirrors, Handle with Extreme Care: Tips for the Professional on the Care and Handling of Mirrors."

1.6 PRECONSTRUCTION TESTING

A. Preconstruction Mirror Mastic Compatibility Test: Submit mirror mastic products to mirror manufacturer for testing to determine compatibility of mastic with mirror backing.

1.7 WARRANTY

A. Special Warranty: 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 PERFORMANCE REQUIREMENTS

A. Sustainable Design Performance Requirements:
   1. Adhesives shall comply with the following:
      a. Low-Emitting Materials: Testing and product requirements of the California Department of Health Services CDPH Standard Method v1.1, using CA Section 01350, Appendix B, New Single-Family Residence Scenario.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Avalon Glass and Mirror Company.
   2. Binswanger Mirror; a division of Vitro America, Inc.
   3. D & W Incorporated.
   4. Donisi Mirror Company.
   5. Gardner Glass, Inc.
   6. Gilded Mirrors, Inc.
   7. Glasswerks LA, Inc.
   8. Guardian Glass; SunGuard.
   9. Head West.
   10. Independent Mirror Industries, Inc.
   11. Lenoir Mirror Company.
   12. National Glass Industries.
   13. Stroupe Mirror Co., Inc.
   14. Sunshine Mirror.
   15. Trulite Glass & Aluminum Solutions, LLC.
   16. Virginia Mirror Company, Inc.
   17. Walker Glass Co., Ltd.

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.

2.3 SILVERED FLAT GLASS MIRRORS

A. Mirrors, General: ASTM C1503.

B. Annealed Monolithic Glass Mirrors: Mirror Select Quality, ultraclear (low-iron) float glass with a minimum 91 percent visible light transmission.
   1. Nominal Thickness: 6.0 mm.

2.4 MISCELLANEOUS MATERIALS

A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

B. Edge Sealer: Coating approved by mirror manufacturer.

C. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors.

2.5 MIRROR HARDWARE

A. 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 edges of mirrors in a single piece.
   1. Bottom Trim: J-channels formed with front leg and back leg not less than 3/8 and 7/8 inch in height, respectively, and a thickness of not less than 0.04 inch.
   2. Finish: Clear bright anodized.

B. Mirror Top Clips: As indicated.

C. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.

D. 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.

2.6 FABRICATION

A. Fabricate cutouts for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrors.

B. Mirror Edge Treatment: Flat polished . Seal edges of mirrors with edge sealer.

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 PREPARATION

A. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating substrates with mastic manufacturer's special bond coating where applicable.

3.3 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. Install mirrors with mastic and 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. Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.

C. Clean exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Clean mirrors as recommended in writing by mirror manufacturer.

END OF SECTION

SECTION 088700 - GLAZING SURFACE FILMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Surface-applied glazing films.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show location and extent of film type. Use same designations indicated on Drawings.

C. Samples: Of each film specified mounted to a glass sample.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of glazing film to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who has completed 5 projects similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
1. Install on window with correct custom color finish.
2. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 FIELD CONDITIONS

A. Lighting: Do not install glazing film until lighting that matches conditions intended for occupants after Project completion is provided on the surfaces to receive glazing film.

B. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by the glazing film manufacturer for full drying or curing.

1.6 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. Glazing Surface Films: For each finish and color installed, furnish roll equal to 10% of amount installed, but enough to replace the film on no less than three windows.

1.7 WARRANTY

A. If application of film voids glazing manufacturer's warranty, provide re-warranty of glazing to match original glazing warranty.

PART 2 - PRODUCTS

2.1 GLAZING SURFACE FILMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. 3M.
   2. Avery Dennison Graphics.
   3. Decorative Films, LLC.
   4. Eastman Performance Films, LLC.
   5. FDC Graphic Films, Inc.
   6. Solyx.

B. UV Resistance: Film to be color-stable when exposed to ultra-violet light.

C. Dimensions: Rolls to be of a width and length to allow application to a window in one sheet without seams.

D. At Communal Restrooms: apply film layers as needed to achieve the below effects. Provide basis of design film Solyx SXB-20-UG Golden Yellow Sand Blast or approved equal.
   1. Color: to match window frame, refer to Section 085413 "Fiberglass Windows" for basis of design color.
   2. Privacy Film: visually obscuring for privacy, applied in conjunction with color film as selected by Architect from manufacturer's standard privacy options.

E. Privacy Film: visually obscuring for privacy, applied in conjunction with color film as selected by Architect from manufacturer's standard privacy options. As indicated on the plan.

2.2 ACCESSORIES

A. Provide accessories and tools recommended by manufacturer for project installation conditions.

PART 3 - EXECUTION

3.1 PREPARATION

A. Comply with manufacturer's written instructions for surface preparation.

3.2 INSTALLATION, GENERAL

A. General: Comply with glazing film manufacturer's written installation instructions applicable to products and applications indicated, except where more stringent requirements apply.

B. Install glazing film with no gaps or overlaps. Make butt splices, if necessary, using straightedge and sharp knife.

3.3 CLEANING

A. Remove excess adhesive at finished seams, perimeter edges, and adjacent surfaces.

B. Use cleaning methods recommended by glazing film manufacturer.

3.4 PROTECTION

A. Attach signs to head of window frame or other conspicuous location reading, "Glazing Film Applied. Do Not Wash. Do not wash these windows or remove this notice until (insert date 30 days after installation)."

END OF SECTION

SECTION 088813 - FIRE-RATED GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Fire-rated glazing materials installed as vision lights in fire-rated doors.
   2. Fire-rated glazing materials installed as sidelites in fire-rated frames.

B. Related Sections:
   1. Section 084123 "Fire Rated Aluminum Framed Entrances and Storefronts."

1.2 DEFINITIONS

A. Fire-Resistance-Rated Glazing: Glazing that prevents spread of fire and smoke and radiant heat and complies with requirements for rated walls and rated openings; capable of blocking radiant heat

B. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

C. Glass Thicknesses: Indicated by thickness designations in millimeters in accordance with ASTM C1036.

1.3 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Submit manufacturer's technical data for each glazing material required, including installation and maintenance instructions.

B. Glass Samples: For each type of glass product; 12 inches (300 mm) square.

C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of glass and glazing product.

C. Product Test Listings: From UL indicating fire-rated glass complies with requirements, based on comprehensive testing of current product.

D. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the NGA's Certified Glass Installer Program.

B. Glazing Standards: FGMA Glazing Manual and Sealant Manual.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials in accordance with manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install fire-resistant glazing until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature conditions at occupancy levels during remainder of construction period.

1.9 WARRANTY

A. Manufacturer's Special Warranty for Tempered Glazing Units with Clear Intumescent Interlayer: Manufacturer agrees to replace units that deteriorate within specified warranty period. Deterioration of tempered glazing units with clear intumenscent interlayer is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning glass contrary to manufacturer's written instructions. Evidence of failure is air bubbles within units, or obstruction of vision by contamination or deterioration of intumescent interlayer.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Glass: For each glass type, obtain from single source from single manufacturer.

B. Glazing Accessories: For each product and installation method, obtain from single source from single manufacturer.

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 defective manufacture, fabrication, or installation; deterioration of glazing materials; or other defects in construction.

B. Provides protection by reducing the radiant and conductive heat transfer.

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. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label UL. Label shall indicate manufacturer's name, type of glass, glass thickness, and safety glazing standard with which glass complies.

2.4 GLASS PRODUCTS

A. Float Glass: ASTM C1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

B. Low-Iron Float Glass: ASTM C1036, Type I, Quality-Q3, Class I (clear), with visible light transmission not less than 91 percent.

C. Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class I (clear) unless otherwise 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.

D. Laminated Glass: ASTM C1172. 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 unless fire-protection or fire-resistance rating is based on another product.
2. Interlayer Thickness: Provide thickness as needed to comply with requirements.
3. Interlayer Color: Clear unless otherwise indicated.

2.5 FIRE-RESISTANCE-RATED GLAZING

A. General: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-resistance ratings indicated, based on testing in accordance with ASTM E119 or UL 263.

B. Fire-Resistance-Rated Glazing Labeling: Permanently mark fire-resistance-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, that glazing is approved for use in walls, and fire-resistance rating in minutes.

C. Fire-Resistance-Rated Framing and Doors: Fire-resistance-rated glazing with 90-minute ratings requires framing and doors from glass supplier, tested as an assembly complying with ASTM E119 or UL 263.

D. Fire-Resistance-Rated Tempered Glazing Units with Clear Intumescent Interlayer: Glazing units made from two or more lites of uncoated, fully tempered, clear low-iron float glass; with a perimeter edge seal enclosing a cavity filled with optically clear, intumescent polymer; complying with 16 CFR 1201, Category II.

1. Provide Basis of Design Product, or approved equivalent:
   a. Pilkington Pyrostop, Distributed by Technical Glass Products (TGP).
2. **GLI-3** At 90-minute rated Fire-Resistance Rated Doors:
   a. Thickness:
      1) 1-7/16, #90-102.
   b. Weight: 17.61 lbs./sq. ft.
   c. Approximate Visible Transmission: 84 percent.
   d. Fire-rating: 90 minute.
   e. Impact Safety Resistance: ANSI Z97.1 and CPSC 16CFR1201 (Cat. I and II).
   f. STC Rating: 45 dB.
3. **GLI-4** At 120-minute rated Fire-Resistance Rated Walls:
   a. Thickness:
      1) 2-1/4", #120-106.
   b. Weight: 23 lbs./sq. ft.
   c. Approximate Visible Transmission: 75 percent.
   d. Fire-rating: 120 minutes.
   e. Impact Safety Resistance: ANSI Z97.1 and CPSC 16CFR1201 (Cat. I and II).
   f. STC Rating: 46 dB.

2.6 GLAZING ACCESSORIES

A. 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.

B. Glazing Sealants for Fire-Rated Glazing Products: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use NT. Comply with sealant

and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated.

1. Dow Corning 795 - Dow Corning Corp.
2. Silglaze-II 2800 - General Electric Co.
3. Spectrem 2 - Tremco Inc.
4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range of industry colors.

C. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.7 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

C. Perimeter Insulation for Fire-Resistance-Rated Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

2.8 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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with manufacturing and installation tolerances, including those for size, squareness, and offsets at corners, and for compliance with minimum required face and edge clearances.

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 fire side and protected side. Label or mark units as needed so that fire side and protected side 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 fire-resistant 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 (1270 mm).

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- (3-mm-) 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 in accordance with requirements in referenced glazing publications.

I. Set glass lites with proper orientation so that coatings face fire side or protected side as specified.

J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended in writing by gasket manufacturer.

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 and then to jambs. Cover horizontal framing joints by applying tapes to jambs and 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 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. 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.

3.6 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 contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

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 088813

SECTION 089119 - FIXED LOUVERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Fixed extruded-aluminum louvers
a. With glazing leg for inclusion in storefront system
2. Blank-off panels for louvers

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

C. Samples: For each type of metal finish required.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on tests performed according to AMCA 500-L.

B. Sample Warranties: For manufacturer's special warranties.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by

louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

1. Wind Loads: Determine loads based on pressures as indicated on Drawings.

B. Seismic Performance: Louvers, including attachments to other construction, shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

C. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.2 FIXED EXTRUDED-ALUMINUM LOUVERS

A. Horizontal Drainable-Blade Aluminum Louver:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Airolite Company, LLC (The).
   b. Construction Specialties, Inc.
   c. Greenheck Fan Corporation.
   d. Ruskin Company
2. Louver Material: Aluminum.
3. Louver Depth: 4 inches.
4. Size: As indicated in the drawings.
5. Net Free Area: As indicated in the drawings.
6. Frame and Blade Nominal Thickness: Not less than 0.060 inch for blades and 0.080 inch for frames.
   a. Provide manufacturer-fabricated frame stiffening for glazing leg anchorage.
7. Glazing leg: Dimensions coordinated with storefront assembly.
8. Mullion Type: Exposed.
9. AMCA Seal: Mark units with AMCA Certified Ratings Seal.
10. Finish: Match adjacent storefront assembly where louvers are included in storefront framing, and prime for field finish to match adjacent cladding elsewhere.

2.3 LOUVER SCREENS

A. General: Provide screen at each exterior louver.

B. Louver Screen Frames: Same type and form of metal as indicated for louver to which screens are attached.

C. Louver Screening:

1. Insect Screening: T-304 Stainless steel, 18 x 18 mesh, 0.009-inch wire.

2.4 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 clips or sheet metal screws.

2.5 MATERIALS

A. Aluminum Extrusions: ASTM B221, Alloy 6063-T5, T-52, or T6.

B. Aluminum Sheet: ASTM B209, 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. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
   2. For color-finished louvers, use fasteners with heads that match color of louvers.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.6 FABRICATION

A. 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.

B. 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.

2.7 ALUMINUM FINISHES

A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
   1. Color: Medium Dark Bronze. (Basis of Design Arcadia AB5).

PART 3 - EXECUTION

3.1 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. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

D. 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.

3.2 ADJUSTING

A. 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.

END OF SECTION

SECTION 092116 - GYPSUM BOARD SHAFT WALL ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Gypsum board shaft wall assemblies.
2. Delegated design.

B. Related Requirements:

1. Section 092216 “Non-Structural Metal Framing."
2. Section 092900 “Gypsum Board."

1.2 SUBMITTALS

A. Product Data: For each component of gypsum board shaft wall assembly.

B. Delegated-Design Submittal: For components indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Evaluation Reports: For shaft wall assemblies and firestop tracks, for fasteners, from ICC-ES.

1.3 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.

1.4 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C840 requirements or with gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Environmental Requirements: Comply with more restrictive of ASTM C840 requirements or with gypsum board manufacturer's written recommendations, under which products can be installed.

1. Maintain minimum uniform 50 degrees F temperature in building for 48 hours before and continuously until applied joint treatment and bonding adhesives are thoroughly dry.
2. Do not allow ambient temperature to exceed 95 degrees F.
3. Provide ventilation to remove moisture in excess of that required for drying of joint treatment materials after its application. Avoid drafts during dry, hot weather to prevent too rapid drying.

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. Delegated Design: Engage a qualified professional engineer, as defined in Section 016116 "Delegated Design Requirements," to design shaft wall and ceiling systems.

1. General: Stud gauges indicated on Drawings are minimum requirements for fire-wall rating requirements and are not to be used other than establishing the minimum requirement.

B. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, furnish and install materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.

1. Tests shall be performed by an approved testing organization in accordance with the California State Fire Marshal's testing procedures. Refer to the Office of the State Fire Marshal for a listing of Approved Testing Laboratories.

C. STC-Rated Assemblies: Furnish and install materials and construction identical to those of assemblies tested according to ASTM E90 and classified according to ASTM E413 by a testing and inspecting agency.

D. Horizontal Deflection: For wall assemblies, limited to 1/240 of the wall height based on horizontal loading of 5 lbf/sq. ft.

1. Furnish and install 10 lbf/sq. ft. or as required by elevator manufacturer at elevator shaft. Confirm pressures with elevator manufacturer in Division 14 Section.

E. Vertical Deflection: For ceiling joists and soffit framing in horizontal assemblies, deflection limited to 1/360 of the span for live loads and 1/240 for total loads of the span.

1. Vertical Loading: 6 lbf/sq. ft.

2.2 MATERIALS

A. Steel Framing Members: Comply with ASTM C645 requirements for metal unless otherwise indicated.

1. Protective Coating: ASTM A653, G60, hot-dip galvanized unless otherwise indicated.

B. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

2.3 GYPSUM BOARD SHAFT WALL AND HORIZONTAL CEILING ASSEMBLIES

A. Fire-Resistance Rating: As indicated.

B. Gypsum Shaftliner Board, Moisture- and Mold-Resistant Type X (UL Type SLX): ASTM C1396; manufacturer's proprietary fire-resistive liner panels with moisture- and mold-resistant core and surfaces.

1. Thickness: 1 inch.

2. Long Edges: Double bevel.

3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

C. Gypsum Board: Type X or Type C, as indicated on Drawings and specified in Section 09 29 00 “Gypsum Board."

D. Non-Load Steel Framing Members: Comply with ASTM C645 requirements for metal unless otherwise indicated.

1. Protective Coating: ASTM A653, G60, hot-dip galvanized unless otherwise indicated.

E. Studs: Manufacturer's standard CH- and E-profiles for repetitive members, corner and end members, and fire-resistance-rated assembly indicated.

1. Depth: As indicated.

2. Minimum Base-Metal Thickness: As required for performance indicated.

F. Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least 2 inches long and matching studs in depth.

1. Minimum Base-Metal Thickness: As required for performance indicated.

2. Firestop Tracks: Furnish and install firestop track at head of shaft wall on each floor level.

G. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

1. Minimum Base-Metal Thickness: As required for performance indicated.

2. Firestop Tracks: Furnish and install firestop track at head of shaft wall on each floor level.

2.4 AUXILIARY MATERIALS

A. General: Furnish and install auxiliary materials that comply with manufacturer's written recommendations.

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 recommendations for application indicated.

C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.

D. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.

1. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing according to ASTM E488 conducted by a qualified testing agency.

2. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing according to ASTM E1190 conducted by a qualified testing agency.

E. Sound Attenuation Blankets: As specified in Section 092900 “Gypsum Board."

F. Acoustical Sealant: As specified in Section 092900 “Gypsum Board."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to which gypsum board shaft wall assemblies attach or abut, with Installer present, including hollow-metal frames, elevator hoistway door frames, cast-in anchors, and structural framing. Examine for compliance with requirements for installation tolerances and other conditions affecting performance.

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 INSTALLATION

A. General: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated, manufacturer's written installation instructions, and ASTM C754 other than stud-spacing requirements.

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, furnish and install jamb struts on each side of door frame.

2. Reinforcing: Where handrails directly attach to gypsum board shaft wall assemblies, furnish and install galvanized steel reinforcing strip with 0.033-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. Firestop Tracks: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

G. Control Joints: Install control joints according to ASTM C840 and in specific locations approved by University's Representative while maintaining fire-resistance rating of gypsum board shaft wall assemblies.

H. Sound-Rated Shaft Wall Assemblies: Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly.

I. Cant Panels at Elevator Shaft: At projections into shaft, install 1/2- or 5/8-inch-thick gypsum board cants covering tops of projections.

1. Slope cant panels at least 75 degrees from horizontal. Set base edge of panels in

adhesive and secure top edges to shaft walls at 24 inches o.c. with screws fastened to shaft wall framing.

2. Where 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.

J. 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.

3.3 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, or mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.

2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

SECTION 092214 - FURRING AND LATHING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section describes the requirements for furnishing and installing metal lath and accessories.

B. Related Sections:
1. Construction waste management is specified in Section 01 74 19.
2. Rough carpentry is specified in Section 06 10 00.
3. Gypsum sheathing is specified in Section 06 16 43.
4. Portland cement plaster and rainscreen drainage mat is specified in Section 09 24 00.

1.2 SUBMITTALS

A. General: Comply with Section 013300.

B. Product Data: Furnish for each type of lath, fastener, and accessory specified.

1.3 QUALITY ASSURANCE

A. Perform work in accordance with the applicable requirements of California Building Code (CBC) Section 2507.2, 2510 and ASTM E2266.
1. Contractor shall maintain a copy of referenced ASTM Standards at the Project site.

B. Industry Association Recommendations: Conform to recommendations of NAAM EMLA 920 – Guide Specifications for Metal Lathing and Furring except where those recommendations conflict with specified requirements.
1. ASTM C926
2. ASTM C1032

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver products and materials in original unopened packages, containers, or bundles with manufacturer's label intact and legible.

B. Remove items delivered in broken, damaged, rusted, or unlabeled condition from Project site immediately.

C. Protect metal lath and accessories from moisture and other sources of damage.

D. Store metallic materials and accessories indoors, off the floor.

PART 2 - PRODUCTS

2.1 METAL LATH

A. Self-Furring Diamond Mesh: 3.4-pounds per square yard, with evenly spaced indentations to hold lath approximately 1/4-inch away from solid surfaces. Use over solid backing.

B. 3/8-Inch Rib Lath: 3.4-pounds per square yard, fabricated in herringbone mesh pattern with 3/8-inch deep ribs. Use at plaster ceilings and soffits only where spacing of framing exceeds 16-inches on center.

2.2 FASTENERS

A. General: Fasteners shall comply with ASTM C1063.

B. Fasteners for Securing Metal Lath to Wood Framing:
1. Horizontal plaster:
   a. 1-1/2 inch Stronghold Staple 9 gauge zinc plated steel with 5/8 inch wide head.
   b. Barbed roofing nails: 1-1/2 inch barbed roofing nails with 7/16 inch head.
2. 1-1/2-inch roofing nails for horizontal applications and 1-inch roofing nails, 1-inch wide crown staples, or 6d common nails bent over to engage at least three strands of lath for vertical applications. Fasteners shall be of sufficient length to penetrate a minimum of 3/4-inch into stud.
3. Staples or nails used to attach 3/8-inch rib lath shall penetrate horizontal framing members a minimum of 1-3/4-inch and vertical framing members a minimum of 3/4-inch. Nails shall be bent over the rib or the staple shall straddle the rib.

C. Fasteners for Securing Metal Lath to Concrete or Concrete Block: Hardened concrete stub nails, minimum 3/4- inch long with minimum 3/8-inch heads, in rows not more than 16-inches on center with fasteners spaced a maximum of 7-inches on center along each row. Provide additional powder-actuated fasteners located at each corner and midway along the long edge of the sheet.

D. Tie Wires: No. 16-gauge, galvanized, single strand annealed steel or No. 13-gauge, galvanized, double strand annealed steel.

2.3 METAL ACCESSORIES

A. General: Minimum 26-gauge zinc alloy, perforated or expanded flanges.
1. Corner Beads: Structa Wire Corp. “Structa Corner” or approved equal.
2. Casing Beads: No. 66 square edge.
3. Corner Reinforcement: Cornerite, minimum 1.75-pounds per square yard expanded metal lath with minimum 2-inch legs.
4. Strip Reinforcement: For reinforcing joints of dissimilar materials and diagonal reinforcement at door, window, and other opening corners, minimum 1.75-pounds per square yard expanded metal lath.

5. Expansion Joints: Stockton M-Slide "MSX" with weep holes or approved equal.
6. Relief or Control Joints: Keene No. 40 unless special shapes are detailed or approved equal.
7. Sill Screed: Manufacturer's standard with weep holes.
8. Soffit Vents: Fry Reglet PCS-100-V-100 or approved equal.
9. Drip Screeds: As indicated on the Drawings, or aluminum.
10. Rainscreen Weep Screed: As required by stucco rainscreen drainage mat manufacturer.
11. Reveals: Fry Reglet or approved equal, finish as selected by the Architect, profiles indicated.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install materials in conformance with NAAM EMLA 920 – Guide Specifications for Metal Lathing and Furring and as specified.

B. Discontinue metal lath behind vertical control joints. Each control joint flange shall be supported by a separate stud.

C. Install control and expansion joint covers in accordance with CBC Chapter 35 referenced standards ASTM C926 and C1063.

3.2 INSTALLATION OF METAL LATH

A. Exterior Surfaces: Comply with ASTM C926.

B. Attach to wood or metal framing or solid backing with specified fasteners spaced 6-inches apart. All fasteners shall penetrate the specified distance into framing.

C. Where solid backing is not provided, apply with long dimension of sheets perpendicular to supports.

D. Metal lath shall be fastened 7-inches on center along both sides of control and expansion joints and 7- inches on center into framing along the base of the wall, in accordance with ASTM C1063.

E. Metal lath shall be continuous in corners.

F. Metal lath shall not be continuous behind expansion or control joints in accordance with ASTM C1063.

G. Insert lath as far as possible into reentrant space of metal frames, and notch to pass around jamb anchors.

H. Where no external corner reinforcement is used, lath shall be furred out and carried around corners at least one support on frame construction.

3.3 INSTALLATION OF METAL ACCESSORIES

A. General:
1. Fasten in place as required to prevent dislodging or misalignment by subsequent operations. Use self-tapping screws on metal framing. Attach over required layers of building paper.
2. Fasten at both ends and at a maximum of 12-inches on center along sides.
3. Bring grounding edge of accessories to true lines, plumb, level, and straight.
4. Install accessories to provide required depth of plaster and to bring plaster surface to required plane.
5. Connect lengths of accessories as recommended by the manufacturer to assure a continuous line. Seal joint end seams, mitered joints and intersections of control and expansion joints with joint sealant in accordance with ASTM C926.
6. Install continuous corner reinforcement for full length of external corners.
7. Install strip reinforcement over metal lath at corners of doors, windows, louvers and other openings.
8. Install casing beads to provide a minimum 1/8-inch clearance between structural units and termination points of surfaces to receive plaster finish.
9. Where location of control joints is not indicated, install control joints at walls and ceilings to create panels no larger than 100-square feet with no dimension exceeding 10-feet or a length-to- width ratio of 2-1/2-to-one in accordance with ASTM E2266. Miter intersections of vertical and horizontal joints and seal with sealant. Joint locations not indicated shall be approved by the Architect.
10. Install sill weep screed as indicated and in accordance with CBC Chapter 35 and ASTM C1063. Terminate paper sheathing and lath on the attachment flange of the screed.

B. Beads:
1. Use single length of metal beads wherever length of run does not exceed longest standard stock length available. Miter or cope corners.
2. Set beads level, plumb, and true to line. Shim as required and align joints with concealed splices or tie plates.
3. Provide casing beads at the following locations:
   a. Where plaster abuts dissimilar construction.
   b. At perimeter of openings where edges of plaster will not be concealed by other work.

END OF SECTION

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Framing systems.
2. Long-span manufactured suspended gypsum board ceiling system.
3. Resilient sound isolation clips and furring channel.

B. Related Requirements:
1. Section 092900 “Gypsum Board” for requirements for gypsum board installed on non-structural metal framing.

1.2 ACTION SUBMITTALS

A. Product Data: Submit manufacturer's technical literature.

B. Samples: 8 inch long samples of suspension system components, including main runner, cross tees and angle molding.

C. Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards.

1.3 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. Manufactured Gypsum Board Ceilings:
a. Ceiling suspension-system members.
b. Structural members to which suspension systems will be attached.
c. Method of attaching hangers to building structure.
1) Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
d. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
e. Seismic struts and bracing.
f. Size and location of initial access modules for acoustical panels.
g. Items penetrating finished ceiling and ceiling-mounted items including the following:
1) Lighting fixtures.
2) Diffusers.
3) Grilles.

4) Speakers.
5) Sprinklers.
6) Access panels.
7) Perimeter moldings.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.

1.5 WARRANTY

A. Suspensions System: Submit a written limited warranty executed by the manufacturer, agreeing to repair or replace grid components that are supplied with a hot-dipped galvanized coating or aluminum base material. Failures include, but are not limited to:

B. The occurrence of 50% red rust as defined by ASTM D 610 test procedures as a result of defects in materials or factory workmanship.

C. Warranty Period:
1. Grid: Ten years from date of installation.
2. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

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 E119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

C. Design framing systems in accordance with American Iron and Steel Institute Publication AISI S220, except as otherwise shown or specified.

D. Provide non-structural metal framing capable of withstanding design loads within limits and under the following conditions:
1. Design Load: 5 lbf/sq. ft. uniform air-pressure differential acting perpendicular to covering material supported by metal framing.
2. Deflection Limits:

a. Ceiling Framing and Suspension System: Design framing to withstand gravity loads without vertical deflection greater than 1/240.

2.2 FRAMING SYSTEMS

A. Framing Members, General: Comply with AISI S220 for conditions indicated.

2.3 MANUFACTURED SUSPENDED GYPSUM BOARD CEILING FRAMING

A. General: Manufactured system of cold formed steel profiles intended to support a gypsum board ceiling with hanger wires spaced up to 9 feet.
   1. Basis of design system or approved equal:
      a. Armstrong ShortSpan Suspension System ESR-2311.

B. Source Limitations: Provide a complete system from one manufacturer. Includes main beams, cross Ts, supports, wall moldings, transition moldings, clips, hangar wires, corner beads, casing beads, control joints and special trim shapes.

C. Material: Minimum 0.0179 inch thick steel prior to protective coating per ASTM C654.

D. Finish: Hot dip galvanized per ASTM A653, G90.

E. Structural Classification:
   1. Main Beam shall be heavy duty per ASTM C 635.
   2. Classification can require wires to be closer together for additional loading when used to support double layer gypsum, verticals, slopes, domes, half barrels, circles, soffits, canopies, and step conditions which call for loading or unusual designs and shapes in drywall construction. Using cross tees in the construction of circles, barrels, etc. is common in order to hold the radius.
   3. Deflection of fastening suspension system supporting light fixtures, ceiling grilles, access doors, verticals and horizontal loads shall have a maximum deflection of 1/360 of the span.

2.4 ACOUSTIC RESILIENT CHANNEL FURRING

A. Framing Members: Comply with ASTM C754 for conditions indicated.
   1. Furring channels: As indicated.
   2. Minimum gauge as required for specific orientation, application and weight of finish.

B. Resilient Sound Isolation Clips: Compatible with furring channels provide one of the products below:
   1. Kinetics Isomax
   2. Pliteq Genieclip
   3. Pac Int'l RISC-1
   4. Or approved equal.

C. Resilient Isolation Strip: Compatible with Resilient sound isolation clip and furring channel.

2.5 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.
   1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Installation Standard: ASTM C754.
   1. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.

B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

D. Install bracing at terminations in assemblies.

E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.2 INSTALLATION OF FRAMING SYSTEMS

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

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 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.

E. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

F. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
   1. Install sound isolation clips in compliance with manufacturer’s written instructions.
   2. Install resilient isolation strip per manufacturer's written instructions and at edge of gypsum board panel to provide closure that acoustically decouples gypsum board and adjacent structure.

3. Install gypsum board fasteners into furring channel only. To avoid short circuiting the sound isolation clips do not use fasteners longer than required for connection of gypsum board to furring channel.
4. Install caulking

3.3 INSTALLATION OF MANUFACTURED SUSPENDED GYPSUM BOARD CEILING FRAMING

A. General:
1. Install suspension system and panels in accordance with the manufacturer's instructions, in compliance with ASTM installation standard, and with applicable codes as required by the authorities having jurisdiction.
2. The system can be installed in interior or exterior applications.
3. To secure to metal clips, concrete inserts, steel bar joist or steel deck, use power actuated fastener, or insert. Coordinate placement for hanger wire spaced as required for expected ceiling loads and layout.
4. Install hanger wire as required with necessary on center spacing to support expected ceiling load requirements, following local practices, codes and regulations. Provide additional wires at light fixtures, grilles, and access doors where necessary. A pigtail knot shall be used with three tight wraps at top and bottom fastening locations.
5. Add additional wire as needed when using compatible clips and accessories.
6. Control Joints: Roll formed zinc alloy, aluminum, or plastic as required for expansion and contraction as shown on drawings.
7. Expansion Joints: Roll formed zinc alloy, aluminum, or plastic as required for expansion and contraction as shown on drawings.
8. T-reinforcement members shall be suspended from the overhead construction with hanger wire or framing, spaced as required for expected ceiling loads, along the length of the main beams.
9. Install main beams at on center spacing as specified by the drywall manufacturer. Typical drywall tee spacing:
   a. 16 inches on center with 5/8 or 1/2 inch gypsum board
   b. 24 inches on center with 5/8 inch gypsum board
10. Other items such as wood, sheet metal, or plastic panels should be screwed to comply with deflection limit equivalent to that of the ceiling installation.
11. Use channel molding or angle molding to interface with Drywall Grid System to provide perimeter attachment or to obtain drop soffits, verticals, slopes, etc.
12. To suspend a second ceiling beneath a new or existing drywall ceiling, without breaching the integrity of the upper ceiling, use the Drywall Clip. To form a transition from a drywall ceiling to an acoustical ceiling, use the Drywall Transition Clips spaced as required for expected loads.
13. For light fixtures (Type G, Type F) use secondary framing cross tees as required to frame opening.
14. Single cross tees in a rout hole to be secured by 7/16 inch framing screw or alternative methods.

B. INSTALLATION – INTERIOR
1. Install main beams and cross tees at the on center spacing required for ceiling loading, and location of in-ceiling services.
2. Additional bracing as required by code.

END OF SECTION

SECTION 092400 – PORTLAND CEMENT PLASTERING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section describes the requirements for furnishing and installing the following type(s) of Portland-cement plaster:
   1. One-coat application over metal lath with elastomeric finish coat.

B. Related Sections:
   1. Section 017419 "Construction Waste Management."
   2. Section 072100 "Thermal Insulation" for continuous wall insulation between plaster finish and air barrier.
   3. Section 092214 "Furring and Lathing" for plaster metal lath and accessories.

1.2 SUBMITTALS

A. General: Comply with Section 013300 "Submittal Procedures."

B. Product Data: Manufacturer's written recommendations, proportion mixes, and installation instructions for each product, including data showing compliance with specified requirements.

C. Samples:
   1. For initial selection purposes, furnish manufacturer's color charts consisting of actual units or sections of units at least 12-inches square showing full range of colors, textures, and patterns available for each type of finish.
      a. Where finish involves normal color and texture variations, include sample sets composed of two or more units showing full range of variations expected.
   2. For verification purposes, furnish units at least 12-inches square sets of each type of texture and color, showing full range of variations expected in the completed work.

D. Certification from an independent Testing Agency that aggregates comply with specified requirements.

E. Sustainable Design Submittals: As specified in Section 018113.

1.3 QUALITY ASSURANCE

A. Code Requirements: Comply with applicable requirements of California Building Code (CBC) Section 2512.

B. Allowable Tolerances of Finished Surface: Maximum deviation from true plane shall not exceed 1/4-inch as measured from the line of a 5-foot straightedge placed at any location on the surface.

C. Mock-Up: Prior to plastering work, fabricate panels for each type of finish and application required to demonstrate aesthetic effects of application and qualities of materials and application.
   1. Location: As approved by the Architect.
   2. Size: minimum 4-foot x 4-foot mock-up using materials and methods to be incorporated in the work.
   3. Demonstrate range of aesthetic effects, including color, texture, and workmanship to be expected in the completed work.
   4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver manufactured materials in original unopened packages or containers with manufacturer's label intact and legible.

B. Keep cement and lime dry, stored off the ground, under cover, and away from damp surfaces.

C. Remove wet and deteriorated materials from Project site.

1.5 JOB CONDITIONS

A. Environmental Requirements:
   1. Provide sufficient heat and ventilation at enclosed areas where plastering is being performed to allow cement plaster to properly cure.
   2. Take precautionary measures necessary to ensure that excessive temperature changes do not occur.
   3. Cold Weather Requirements: Do not apply cement plaster unless minimum ambient temperature of 50-degrees F. has been and continues to be maintained for a minimum of 48-hours prior to application and until plaster is cured.
   4. Hot Weather Requirements: Protect cement plaster from uneven and excessive evaporation during hot, dry weather.

B. Protection:
   1. Cover building openings in areas adjacent to plastering work with plastic film.
   2. Protect finished surfaces installed prior to plastering by covering with a suitable non-staining material. Cover metal frames with plastic film.
   3. Maintain protection in place until completion of plastering work.

C. Pre-Application Conference: Prior to commencement of portland cement plastering, hold a pre-application conference at the Project site to discuss materials and

procedures to be used. Conference shall be attended by the Architect, Contractor, Owner's Representative and plastering subcontractor.

PART 2 - PRODUCTS

2.1 BASE COAT MATERIALS

A. General: A premixed portland cement base coat with plasticizing agents and admixtures, plastic cement, or blended cement that meets ASTM C926 and CBC Chapter 25, intended for application as one coat.
   1. Basis of Design: Western Building Products Western 1-Kote Premium Gray Concentrate.
      a. Provide Basis of Design or equal.

B. Portland Cement: ASTM C150, Type I or Type II.

C. Hydrated Lime: ASTM C206, Type S, certified not less than 99-percent hydrated.

D. Aggregates: ASTM C897.
   1. Gradation, Base (Scratch and Brown) Coats:

U.S. Standard Sieve	Percent Retained by Weight (+2%)	
	Minimum	Maximum
No. 8 (2.35 mm)	0	10
No. 16 (1.18 mm)	10	40
No. 30 (600 um)	30	65
No. 50 (300 um)	70	90
No. 100 (150 um)	95	100

   2. Independent Testing Agency shall sample aggregate on the Project site and test for compliance with specified ASTM C897 standard.

E. Fiber Reinforcing: 1/2-inch alkaline-resistant chopped-glass fibers or alkaline-resistant polypropylene fibers. Detergent admixtures or clay to aid in pumping plaster will not be permitted.

F. Water: Clean, potable, and free from substances harmful to plaster.

2.2 FINISH COAT MATERIALS

A. Factory-prepared integral elastomeric color finish coat containing all materials required for finish coat, except water; semi-smooth acrylic finish, integral color as indicated on the Drawings or as selected by the Architect.
   1. Basis of design: Provide basis of design product or equal code compliant stucco approved for application over continuous mineral wool insulation board:
      a. Western Building Products Western Premium Acrylic Finish (PAF) – SuperFine Finish.
         1) Western Building Products PAF Primer
   2. Color: To match architect's sample:

a. P-219 Tungsten.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify that surfaces to be plastered are free of dust, loose particles, oil, and other foreign matter which would affect bond of plaster coats.

B. Examine construction, grounds, and accessories to ensure that finished plaster surfaces will be true to line, level, and plumb, without requiring additional thickness of plaster.

C. Do not commence installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Solid surfaces shall have the suction and surface roughness to provide the bond required for the plaster.

B. Prepare smooth and nonabsorbent solid surfaces including cast-in-place concrete, precast concrete, or concrete masonry to receive portland cement plaster in accordance with CBC Section 2510.7.

C. Apply drainage mat per manufacturer's written instructions with recommended fasteners and accessories.

3.3 APPLICATION

A. Number of Coats:
1. Provide one-coat application over metal lath in accordance with ASTM C926.

B. Three-Coat Application:
1. Apply plaster by hand
2. Interrupt plaster coats only at junctions of plaster planes, at openings, or at control joints.
3. Apply scratch coat with sufficient material and pressure to form full keys through and to embed metal base. When firm, score in one direction.
4. Apply brown coat to scratch coat, bringing out to grounds, flat to true surface, and free of imperfections which would reflect in finish coat.
5. Reconsolidate brown coat by floating and roughen to assure bond with finish coat.
6. Apply finish coat in accordance with manufacturer's instructions and uniformly float to true, even surface.
7. Nominal Plaster Thickness Measured from Face of Lath, in accordance with ASTM C929, Table 4:
   a. Scratch/brown Coat: 3/8-inch, minimum.
   b. Finish Coat: 1/8-inch, minimum.

C. Curing:
1. Maintain moist conditions by fine fog spraying.
2. Cure scratch/brown coat for a minimum of 48-hours.

3.4 COMPLETION

A. Patching:
1. Upon completion of application, point up plaster around trim and other locations where plaster meets dissimilar materials.
2. Cut out and patch defective or damaged plaster.
3. Match patching of defective or damaged plaster to existing work in form, texture, and color.

B. Cleaning:
1. Remove plaster and protective materials from control and expansion joints, perimeter beads, and adjacent surfaces.
2. Remove stains that would adversely affect subsequent finishes on plaster.

C. When complete, plaster surfaces shall be flat or uniformly curved, true to plane; and free from scaffold and tool marks, stains, or other damage or defects and shall be uniform in texture.

3.5 CONSTRUCTION WASTE MANAGEMENT

A. General: Comply with the requirements of Section 017419 “Construction Waste Management and Disposal” for removal and disposal of construction debris and waste.

B. Separate and recycle waste materials to the maximum extent possible.

END OF SECTION

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Interior gypsum board.

B. Related Sections:
1. Section 061643 "Gypsum Sheathing" for gypsum sheathing for exterior walls.
2. Section 061656 “Air-Barrier Water-Resistant Sheathing System” for gypsum-based sheathing air- and water-resistant sheathing.
3. Section 092216 “Non-Structural Metal Framing" for furring channels, resilient sound isolation clips and accessories and other non-structural metal framing supports.
4. Section 093000 "Tiling" for backer units installed as substrates for ceramic tile.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:
1. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

1.3 QUALITY ASSURANCE

A. 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 texture finish indicated.
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.

1.4 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, moisture damaged, and mold damaged.
   1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 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 E90 and classified according to ASTM E413 by an independent testing agency.

C. Sustainable Design Performance Requirements:
   1. Adhesives shall comply with the following:
      a. Low-Emitting Materials: Testing and product requirements of the California Department of Health Services CDPH Standard Method v1.1, using CA Section 01350, Appendix B, New Single-Family Residence Scenario.

2.2 INTERIOR GYPSUM BOARD

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. American Gypsum.
   2. CertainTeed Gypsum.
   3. Continental Building Products, LLC.
   4. Georgia-Pacific Gypsum LLC.
   5. National Gypsum Company.
   6. PABCO Gypsum.
   7. USG Corporation.

B. Gypsum Board, Type X: ASTM C1396/C1396M.
   1. Thickness: 5/8 inch.
   2. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

C. Moisture- and Mold-Resistant Gypsum Board: ASTM C1658/C1658M. With fiberglass mat laminated to both sides. Specifically designed for interior use.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Georgia-Pacific Gypsum LLC; DensArmour Plus.
      b. National Gypsum Company; eXP Interior Extreme.
      c. USG Corporation; Sheetrock Glass-Mat Panels Mold Tough.

2. Core: 5/8 inch, Type X.
3. Long Edges: Tapered.
4. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.3 TRIM ACCESSORIES

A. Interior Trim: ASTM C1047.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
a. Fry Reglet Corporation.
b. Gordon, Inc.
c. Pittcon Industries.
2. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.
3. 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.

2.4 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C475/C475M.

B. Joint Tape:
1. Interior Gypsum Board: Paper.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping or drying-type, all-purpose compound.
a. Use setting-type compound for installing paper-faced metal trim accessories.
3. Fill Coat: For second coat, use setting-type, sandable topping or drying-type, all-purpose compound.
4. Finish Coat: For third coat, use setting-type, sandable topping or drying-type, all-purpose compound.
5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound or high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.

D. Joint Compound for Glass-Mat-Faced Gypsum Board: Use setting-type taping compound and setting-type, sandable topping compound.:

2.5 AUXILIARY MATERIALS

A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.

D. Sound-Attenuation Blankets: As specified in Section 098100 "Acoustic Insulation."

E. Acoustical Sealant: As specified in Section 079200 "Joint Sealants."

F. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

G. Vapor Retarder: As specified in Section 072600 "Vapor Retarders."

2.6 TEXTURE FINISHES

A. Primer: As recommended by textured finish manufacturer.

B. Non-Aggregate Finish: Premixed, vinyl texture finish for spray application.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. CertainTeed Corporation; ProRoc Easi-Tex Spray Texture.
   b. USG Corporation; BEADEX FasTex Wall and Ceiling Spray Texture.
2. Texture: Spatter knock-down.

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 INSTALLATION AND FINISHING OF PANELS, GENERAL

A. Comply with ASTM C840.

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. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.

I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Type X: Vertical surfaces unless otherwise indicated.
2. Moisture- and Mold-Resistant Type: As indicated on Drawings.

B. Single-Layer Application:
1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum panels vertically (parallel to framing) or horizontally (perpendicular to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
   a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
   b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:
1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

3.4 INSTALLATION OF TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints at locations indicated on Drawings.

C. Interior Trim: Install in the following locations:
1. Cornerbead: Use at outside corners unless otherwise indicated.
2. LC-Bead: Use at exposed panel edges.
3. L-Bead: Use where indicated.
4. U-Bead: Use where indicated.

3.5 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 C840:
   1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
   2. Level 3: For areas behind applied wood finishes unless otherwise indicated.
   3. Level 4: For areas exposed to view unless otherwise indicated.
      a. Primer and its application to surfaces are specified in Section 099100 "Painting."
   4. Level 5: At accent walls and behind wall finishes where indicated on Drawings.
      a. Primer and its application to surfaces are specified in Section 099100 "Painting and Coating."

E. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.

3.6 PROTECTION

A. Protect adjacent surfaces from joint compound and promptly remove from floors and other non-gypsum board surfaces. Repair surfaces stained, marred, or otherwise damaged during application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
   1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

SECTION 093000 - TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Ceramic tile.
2. Edge-protection and transition profiles for floors and walls.
3. Tile backing panels.
4. Setting materials.
5. Waterproof crack isolation membranes.
6. Sloped shower pans.

B. Related Sections:
1. Section 035216 “Lightweight Insulating Concrete” for related requirements and acoustic underlayment system.
2. Section 079200 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
3. Plumbing specifications for integrated shower and floor drains.

1.2 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.

1.3 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.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

C. Samples:
1. Each type and composition of tile and for each color and finish required.
2. Trim pieces including finish.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials, from the same production run, to Owner that match 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.

1.6 QUALITY ASSURANCE

A. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

1.7 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.

1.8 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
   1. Build mockup of each type of floor tile installation and wall tile installation with an example of each type of transition from wall to floor, from wall to wall, from floor/wall tile to corridor finishes, from tile finish to other finish as present in the project.
   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 MANUFACTURERS

A. Manufacturers for Setting and Grouting Materials:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Custom Building Products.
      b. H.B. Fuller Construction Products Inc. / TEC.
      c. LATICRETE SUPERCAP, LLC.
      d. MAPEI Corporation.
      e. Merkrete; a Parex USA, Inc. brand.

B. Source Limitations for Setting and Grouting Materials: Obtain setting and grouting materials from single manufacturer and aggregate from single source or producer.

2.2 CERAMIC TILE PRODUCTS

A. ANSI Ceramic Tile Standard: Provide Standard-grade tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

B. Ceramic Tile: Vitreous or impervious natural clay or porcelain; 1/4 inch thick, unless otherwise indicated. As scheduled on Drawings. Refer to Finish Schedule.

2.3 CERAMIC TILE EDGE PROTECTION AND TRANSITIONS

A. Subject to requirements, provide products from the Basis of Design manufacturer or approved equal:
   1. Schluter.

B. Material: Aluminum.

C. Finish: Textured powder coat.

D. Color: As indicated.

E. Profiles:
   1. Floor transition profile
   2. Edge protection profile for walls
      a. Provide with straight anchoring leg
   3. Movement joints at countertop
   4. Cove transition profile between floor and wall tile
      a. Provide with matching inside corners
      b. Provide with matching outside corners
      c. Provide with matching end caps
      d. Provide with matching connectors

2.4 TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Board: ASTM C1178/C1178M, with manufacturer's standard edges.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. CertainTeed Corporation; GlasRoc Tile Backer.
      b. Georgia-Pacific Gypsum LLC; DensShield Tile Backer.
      c. National Gypsum Company; eXP Tile Backer.
      d. USG Corporation; Durock Glass-Mat Tile Backerboard.
   2. Core: 5/8 inch, Type X.
   3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.5 WATERPROOF AND CRACK ISOLATION MEMBRANES

A. General: Manufacturer's standard product that complies with ANSI A118.10 and ANSI A118.12 and is recommended by manufacturer for application indicated. Include reinforcement and accessories recommended by manufacturer.
   1. Compatible with sloped shower pan system.

2.6 SHOWER PAN SYSTEM

A. Provide Basis of Design system or approved equivalent:
   1. Schluter Kerdi System complete shower pan system with integrated waterproofing membrane and drains seamlessly connected to floor and wall tile waterproof and crack isolation membranes.
   2. Provide system and accessories compatible with substrates:
      a. Concrete at ground floor.
      b. Mortar and acoustic membrane over plywood at upper floors.
   3. Form: No curb, flush roll-in transition.

2.7 SETTING MATERIALS

A. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.
   1. Cleavage Membrane: Installer's option of material that complies with ANSI A108.02, paragraph 3.8.
   2. Latex Additive: [Manufacturer's standard] [acrylic resin] [or] [styrene-butadiene-rubber] 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.

B. Modified Dry-Set Mortar (Thinset): ANSI A118.4.
   1. Provide prepackaged, dry-mortar mix to which only water must be added at Project site.
   2. Provide prepackaged, dry-mortar mix combined with liquid-latex additive at Project site.
   3. For wall applications, provide nonsagging mortar.

2.8 GROUT MATERIALS

A. Grout Colors (GT): As selected by Architect from manufacturers full range.

B. High-Performance Tile Grout: ANSI A118.7.

2.9 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. 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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
   1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
   2. Verify that concrete substrates for tile floors installed with dry-set mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
      a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
      b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
   3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
   4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with dry-set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Where indicated, prepare substrates to receive waterproof membrane by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.

C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

D. Acoustic underlayment:
   1. Do not install mechanical fasteners that penetrate through the sound control materials.

3.3 INSTALLATION OF TILE BACKING PANEL AND SLOPED SHOWER PANS

A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Use modified dry-set mortar for bonding material unless otherwise directed in manufacturer's written instructions.

3.4 EDGE-PROTECTION AND TRANSITION PROFILES

A. Consult Manufacturer’s current technical literature for proper design and installation instructions.

3.5 WATERPROOF AND CRACK ISOLATION MEMBRANE INSTALLATION

A. Install complete and watertight membranes in compliance with manufacturer’s written instructions.

3.6 TILE INSTALLATION

A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

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. 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.

E. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
   1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
   2. Locate expansion joints as recommended by tile and tile installation material manufacturers, but not less than the following:
      a. Interior Locations: 20-25 feet in each direction.

b. Interior Locations at Above Ground Concrete Slabs: 8-12 feet in each direction.
c. Interior Locations Exposed to Direct Sunlight or Moisture: 8-12 feet in each direction.
d. Exterior Locations: 8-12 feet in each direction.
e. Perimeter joints.

3.7 CLEANING AND PROTECTION

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.

C. 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.

D. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

E. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

END OF SECTION

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Acoustical panels and exposed suspension systems for interior ceilings.
2. Suspended acoustical ceiling cloud panels and hardware.
3. Suspended shaped acoustical ceiling forms and hardware.

B. Related Requirements:
1. Section 092216 “Non-Structural Metal Framing” for long-span manufactured ceiling framing systems and supports for gypsum board ceilings.
2. DSA IR 25-2.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified, 6 inches in size.

1.3 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. Suspended Acoustic Panel Ceilings:
a. Ceiling suspension-system members.
b. Structural members to which suspension systems will be attached.
c. Method of attaching hangers to building structure.
1) Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
d. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
e. Seismic struts and bracing.
f. Size and location of initial access modules for acoustical panels.
g. Items penetrating finished ceiling and ceiling-mounted items including the following:
1) Lighting fixtures.
2) Diffusers.
3) Grilles.
4) Speakers.
5) Sprinklers.

6) Access panels.
7) Perimeter moldings.

2. Suspended Acoustic Ceiling Clouds and Forms:
   a. Suspension accessories and fasteners.
   b. Structural members to which suspension systems will be attached.
   c. Seismic bracing where suspended acoustic ceiling clouds and forms swinging 45 degrees in any direction will impact fixed construction.
   d. Locations of other systems:
      1) Lighting fixtures.
      2) Diffusers.
      3) Grilles.
      4) Speakers.
      5) Sprinklers.
      6) Access panels.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

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. Acoustical Ceiling Units: Full-size panels equal to 2 percent of quantity installed.
   2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.
   3. Hold-Down Clips: Equal to 2 percent of quantity installed.
   4. Impact Clips: Equal to 2 percent of quantity installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide products indicated or comparable product by one of the following:
   1. Armstrong World Industries, Inc.
   2. CertainTeed Corporation.
   3. Rockfon (Rockwool International).
   4. USG Corporation.
   5. Or equal.

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: Suspended ceilings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame-Spread Index: Class A according to ASTM E1264.
2. Smoke-Developed Index: 50 or less.

2.3 ACOUSTICAL PANELS

A. Acoustical Panel Standard: Manufacturer's standard panels according to ASTM E1264.

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings, or equivalent.
1. ACP-1: Armstrong Ultima Tegular 24" x 24"
2. ACP-2: Armstrong Ultima Plank 24" x 72"

C. Suspension: Provide Metal Suspension System (MSS)

2.4 ACOUSTICAL CLOUD PANELS AND SHAPED ACOUSTICAL FORMS

A. Basis of Design Product: Subject to compliance with requirements, provide product indicated on Drawings, or equivalent.
1. ACP-4: Turf Plate
2. ACP-5: Buzzi Space Buzzi Donut

B. Suspension: Provide manufacturer's standard suspension clips, cables, backings and fasteners.

2.5 METAL SUSPENSION SYSTEM (MSS)

A. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C635/C635M and designated by type, structural classification, and finish indicated.

B. MSS-1:
1. Wide-Face, Capped, Double-Web, 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 15/16-inch- wide metal caps on flanges.
a. Basis-of-Design Product: Subject to compliance with requirements, provide the following:
1) Armstrong World Industries, Inc.; Prelude XL.
b. Structural Classification: Heavy-duty system.
c. End Condition of Cross Runners: Override (stepped) or butt-edge type.
d. Face Design: Flat, flush.
e. Cap Material: Cold-rolled steel or aluminum.

f. Cap Finish: Painted white.

2.6 ACCESSORIES

A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

B. Wire Hangers, Braces, and Ties: Provide wires as follows:
1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
2. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C635/C635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.106-inch- diameter wire.

C. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.

D. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.

E. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch-thick, galvanized-steel sheet complying with ASTM A653/A653M, G90 coating designation; with bolted connections and 5/16-inch- diameter bolts.

F. Seismic Clips: Manufacturer's standard seismic clips designed to secure acoustical panels in place during a seismic event.

G. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.

H. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

I. Seismic Perimeter Retention System:
1. Seismic Perimeter Clips: Manufacturer's standard clips designed to accommodate seismic forces.
a. Basis-of-Design Product: Subject to compliance with requirements, provide the following:
1) Armstrong World Industries, Inc; BERC Series.
2) USG Corporation; ACM7 Seismic Clip.
b. Molding Profile: Manufacturer's standard 7/8-inch-wide profile, as selected by Architect.

2.7 METAL EDGE MOLDINGS AND TRIM

A. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard 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. Edge moldings shall fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.
2. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

B. Acoustical Sealant: As specified in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated.

B. Layout openings for penetrations centered on the penetrating items.

3.2 ACOUSTIC PANEL CEILING INSTALLATION

A. Install acoustical panel ceilings according to ASTM C636/C636M, 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 to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. 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. 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.
7. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. 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 at intervals not more than 16 inches o.c. and not more than 3 inches from ends. 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 precise fit.
1. Arrange directionally patterned acoustical panels as follows:
   a. As indicated on reflected ceiling plans.
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. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
4. Install seismic clips in areas indicated; space according to panel manufacturer's written instructions unless otherwise indicated.

3.3 ACOUSTICAL CLOUD PANEL AND SHAPED FORM INSTALLATION

1. Install in compliance with manufacturer’s written instructions.

3.4 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.

B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 096500 - RESILIENT FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Resilient sheet flooring.
2. Resilient static-dissipative sheet flooring.
3. Resilient tile flooring.

B. Related Sections:
1. Section 035411 "Floor Substrate Preparation."
2. Section 096513 "Resilient Base and Accessories" for rubber wall base and metal stair nosings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:
1. Laboratory Test Reports: For adhesives, and floor covering products, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: For each type of resilient flooring.
1. Include flooring layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
2. Show orientations and details of special patterns.

D. Samples: For each exposed product and for each color, texture, and pattern specified, in manufacturer's standard size, but not less than 6-by-9-inchsections.
1. For resilient sheet flooring, provide sample of seam in project-specific flooring.

E. Product Schedule: For resilient flooring. Use same designations indicated on Drawings.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of resilient flooring to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for resilient flooring installation indicated.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials, from the same production run, to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Resilient Sheet Flooring: Full-width rolls equal to 5 percent of amount installed for each type, color, and pattern indicated, but not less than 10 sq. yd..
   2. Resilient Tile and Plank Flooring: Furnish no fewer than 1 box for each 50 boxes or fraction thereof, of each type, color, pattern, and size of resilient flooring product installed.

1.6 WARRANTY

A. Special Warranty for Resilient Flooring Products: Manufacturer agrees to repair or replace components of flooring installation that fail in materials or workmanship within specified warranty period.
   1. Warranty does not include deterioration or failure of flooring due to unusual traffic, failure of substrate, vandalism, or abuse.
   2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient flooring, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.
   1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

B. Sustainable Design Performance Requirements:
   1. Flooring products and adhesives shall comply with the following:
      a. Low-Emitting Materials: Testing and product requirements of the California Department of Health Services CDPH Standard Method v1.1, using CA Section 01350, Appendix B, New Single-Family Residence Scenario.

2.2 RESILIENT SHEET FLOORING

A. Linoleum Sheet Flooring:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings, or equal.

B. Static-dissipative Linoleum Sheet Flooring:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings, or equal.
   2. Install complete system including electrical grounding.

2.3 RESILIENT TILE FLOORING

A. Linoleum Floor Tile:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings, or equal.

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 flooring manufacturer for applications indicated.
1. Refer to Section 035411 "Floor Substrate Preparation."

B. Adhesives: Water-resistant type recommended by flooring and adhesive manufacturers to suit resilient flooring and substrate conditions indicated.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to resilient flooring manufacturer's written instructions to ensure adhesion of resilient flooring.

B. Concrete Substrates: Prepare according to ASTM F710.
1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by resilient flooring manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by resilient flooring manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing.
4. Moisture Testing: Perform moisture tests recommended in writing by resilient flooring manufacturer. Proceed with installation only after substrates fall within range recommended by manufacturer in writing.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install resilient flooring until materials are the same temperature as space where they are to be installed.
1. At least 48 hours in advance of installation, move flooring and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient flooring.

3.2 STATIC-DISSIPATIVE SHEET FLOORING ELECTRICAL GROUNDING

A. Comply with manufacturer's written instructions for installation of electrical grounding system.

B. Coordinate connection of electrical grounding system to building grounding with electrician.

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. 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.

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 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.

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. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

H. Adhere floor tiles to 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 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient flooring.

B. Perform the following operations immediately after completing resilient 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 flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient flooring until Substantial Completion.

END OF SECTION

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Resilient wall base and metal stair nosings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:
1. Laboratory Test Reports: For resilient accessories, and adhesives, indicating compliance with requirements for low-emitting materials.

C. Samples: For each exposed product and for each color and texture specified, not less than 12 inches long.

1.3 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials, from the same production run, to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Resilient Wall Base: Full-length pieces equal to 5 percent of amount installed for each type, color, and pattern indicated, but not less than 100 lineal feet.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sustainable Design Performance Requirements:
1. Resilient accessories, and adhesives shall comply with the following:
a. Low-Emitting Materials: Testing and product requirements of the California Department of Health Services CDPH Standard Method v1.1, using CA Section 01350, Appendix B, New Single-Family Residence Scenario.

2.2 RUBBER ACCESSORIES

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.
1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings.

C. Wall base: ASTM F2169.
   1. Type: TS (rubber, vulcanized thermoset).
   2. Length: Manufacturer's standard lengths.
   3. Profile: Provide profiles indicated in the Drawings.
      a. Size: As indicated in the Drawings.

D. Colors and Patterns: As selected by Architect from manufacturer's full range, and as indicated in the Drawings, or equal.

E. Metal stair tread nosings: As indicted on finish schedule.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

C. Stair-Tread Nose Filler: Two-part epoxy compound recommended by resilient stair-tread manufacturer to fill nosing substrates that do not conform to tread contours.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

C. Do not install resilient products until materials are the same temperature as space where they are to be installed.

D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.2 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Stair Accessories:
   1. Install metal stair nosing, slot stair-riser resilient flooring into metal stair nosing.
   2. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
   3. Tightly adhere to substrates throughout length of each piece.
   4. For treads installed as separate, equal-length units, install to produce a flush joint between units.

3.3 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION

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 flooring.
2. Integral cove base

B. Related Sections:

1. Section 03 15 00 "Concrete Accessories" for vapor control.
2. Section 03 30 00 "Cast-In-Place Concrete"

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review manufacturer's written instructions for substrate preparation and environmental conditions affecting resinous flooring installation.
2. Review details of integral cove bases.
3. Review manufacturer's written instructions for installing resinous flooring systems.
4. Review protection measures for adjacent construction and installed flooring, floor drainage requirements, curbs, base details, and so forth.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's technical data, installation instructions, and recommendations for each resinous flooring component required.

B. Samples: For each resinous floor system required and for each color and texture specified, 6 inches square in size, applied to a rigid backing by Installer for this Project.

C. Samples for Initial Selection: For each type of exposed finish required.

D. Samples for Verification: For each resinous flooring system required and for each color and texture specified, 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. Material Certificates: For each resinous flooring component.

C. Material Test Reports: For each resinous flooring system, by a qualified testing agency.

D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For resinous flooring to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A minimum of 10 years experience in the production, sales, and technical support of epoxy and urethane industrial flooring and related materials.

B. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.

2. The installer shall have experience in all phases of surface preparation and application of the product specified

1.8 MOCKUPS:

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

B. Apply full-thickness mockups on 96-inch- square floor area directed by Architect.
1. Include 96-inch length of integral cove base with inside corner.

C. Simulate finished lighting conditions for Architect's review of mockups.

D. 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, clearly identified with the product type and batch number and directions for storage and mixing with other components.

B. Storage and Protection

1. The Applicator shall be provided with a dry storage area for all components. The area shall be between 60 F and 85 F, dry, out of direct sunlight and in accordance with the Manufacturer's recommendations and relevant health and safety regulations.

2. Copies of Safety Data Sheets (SDS) for all components shall be kept on site for review by Inspector of Record.

C. Waste Disposal

1. The Applicator shall be provided with adequate disposal facilities for non-hazardous waste generated during installation of the system.

1.10 FIELD CONDITIONS

A. Environmental Limitations:

1. Application may proceed while air, material and substrate temperatures are between 60 F and 85 F providing the substrate temperature is above the dew point. Outside of this range, the Manufacturer shall be consulted.

2. The relative humidity in the specific location of the application shall be less than 85 % and the surface temperature shall be at least 5 F above the dew point.

3. The Applicator shall be supplied with adequate lighting equal to the final lighting level during the preparation and installation of the system.

B. Conditions of new concrete to be coated with cementitious urethane material.

1. Concrete shall be moisture cured for a minimum of 7 days and have fully cured for 14 days in accordance with ACI-308 prior to the application of the coating system pending moisture tests. Outside of these parameters manufacturer shall be consulted.

2. Concrete shall have a flat rubbed finish, float or light steel trowel finish (a hard steel trowel finish is neither necessary nor desirable).

3. Sealers and curing agents should not to be used.

4. Concrete surfaces on grade shall have been constructed with a vapor barrier to protect against the effects of vapor transmission and possible delamination of the system.

C. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring installation.

D. Close spaces to traffic during resinous flooring installation and for 24 hours after installation unless manufacturer recommends a longer period.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Flammability: Self-extinguishing in accordance with ASTM D635.

2.2 RESINOUS FLOORING

A. Resinous Flooring System: Abrasion-, impact-, and chemical-resistant, aggregate-filled, resin-based monolithic floor surfacing designed to produce a seamless floor and integral cove base.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Duraflex, Inc. (Basis-of-Design)
    b. STONHARD
    c. Crown Polymers Corp.

B. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Obtain secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from manufacturer recommended in writing by manufacturer of primary materials.

C. System Characteristics:

1. Color and Pattern: As selected by Architect from manufacturer's full range
2. Wearing Surface: Textured for slip resistance
3. Overall System Thickness: 3/16 inch (4.8 mm) thickness.

D. System Description

1. The work shall consist of preparation of the substrate, the furnishing and application of a cementitious urethane based self-leveling seamless flooring system.

2. The system shall have the color and texture as specified with a nominal thickness of 3/16 inch. It shall be applied to the prepared area(s) strictly in accordance with the Manufacturer's recommendations.

3. Cove base shall be applied per manufacturers standard details unless otherwise noted.

E. Primer: Poly-Crete TF Plus

1. Percent Solids: 100 %
2. VOC: 0g/L
3. Compressive Strength: 7,250 psi in accordance with ASTM C 579.
4. Tensile Strength: 750 psi in accordance with ASTM D 638.
5. Flexural Strength: 4,400 psi in accordance with ASTM D 790.
6. Abrasion Resistance: H 10 Wheel, 1,000 gm load, 1,000 cycles, 40 mg weight loss in accordance with ASTM C 501
7. Hardness, Shore D: 85
8. Potlife 1 gal @ 77 F, 15 minutes

F. Topping: Poly-Crete MD

1. Percent Reactive: 100 %
2. VOC: 0g/L
3. Bond Strength to Concrete in accordance with ASTM D 4541.: >400 psi, substrates fails
4. Compressive Strength: 9,000 psi in accordance with ASTM C 579.
5. Tensile Strength: 2,175 psi in accordance with ASTM D 638.
6. Impact Resistance @ 125 mils, MIL D-3134: >160 inch lbs No visible damage or deterioration

2.3 INTEGRAL COVE BASE ACCESSORIES

A. Precast, Integral Cove Base: Impact-resistant, polymer-resin, cove base moldings with a grit profile to promote adhesion of resinous flooring and recommended in writing by resinous flooring manufacturer.

1. Radius Cove Base: 6-inch- (152-mm-) high base molding that provides approximately 1-inch (25-mm) radius cove at floor-to-wall joint; for adhesive installation as substrate for resinous flooring system to form an integral cove base.

a. Preformed Inside and Outside Corners: Provide manufacturer's standard square inside and square outside corners.

B. Installation Adhesive: As recommended in writing by accessory manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content, installation tolerances and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges,

depressions, scale, and foreign deposits that might interfere with adhesion of resinous flooring systems.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare and clean substrates in accordance with resinous flooring manufacturer's written instructions for substrate indicated to ensure adhesion.

B. Moisture Testing: Perform tests recommended by manufacturer.

1. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 99% relative humidity level measurement.

2. If the relative humidity exceeds 99%, install a vapor mitigation system according to Specification Section 090561.13 Moisture Vapor Emission Control.

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. All surface and embedded accumulations of paint, toppings, hardened concrete layers, laitance, power trowel finishes and other similar surface characteristics shall be completely removed leaving a bare concrete surface having a minimum profile of CSP 4-5 as described by the International Concrete Repair Institute.

c. Floor areas inaccessible to the mobile blast machines shall be mechanically abraded to the same degree of cleanliness, soundness and profile using diamond grinders, needle guns, bush hammers, or other suitable equipment.

d. Wherever a free edge will occur, including doorways, wall perimeters, expansion joints, columns, drains and equipment pads, a ¼ inch deep by ¼ inch wide keyways shall be cut in.

e. Cracks and joints (non-moving) greater than 1/4 inch wide are to be chiseled or chipped-out and repaired per manufacturer's recommendations.

2. Repair damaged and deteriorated concrete in accordance with resinous flooring manufacturer's written instructions.

3. Alkalinity and Adhesion Testing: Perform tests recommended in writing by resinous flooring manufacturer. Proceed with installation only after substrate alkalinity is not

less than 6 or more than 8 pH unless otherwise recommended in writing by flooring manufacturer,

D. Patching and Filling: Use patching and fill material to fill holes and depressions in substrates in accordance with manufacturer's written instructions.

1. Control Joint Treatment: Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring in accordance with manufacturer's written instructions.

E. Resinous Materials: Mix components and prepare materials in accordance with resinous flooring manufacturer's written instructions.

3.3 INSTALLATION

A. Apply components of resinous flooring system in accordance with manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness specified.

1. Coordinate installation of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
2. Cure resinous flooring components in accordance with manufacturer's written instructions. Prevent contamination during installation 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 spreading rate recommended in writing by manufacturer.

1. The primer shall be applied with a coverage rate of 80-90 sf/kit.
2. The primer shall be comprised of a liquid resin, liquid hardener and activator powder and installed per the manufacturer’s recommendations.

C. Integral Cove Base Accessories: Adhesively install precast accessories before applying flooring coats and in accordance with manufacturer's written instructions.

D. Topcoats: Apply topcoats in number indicated for flooring system specified, at spreading rates recommended in writing by manufacturer, and to produce wearing surface specified.

1. The topping shall be applied as a self-leveling system as specified. The topping shall be applied in one lift with a nominal thickness of 3/16 inch.
2. The topping shall be comprised of three components, a resin, hardener and filler as supplied by the Manufacturer.
3. The hardener shall be added to the resin and thoroughly dispersed by suitably approved mechanical means. Aggregate shall then be added to the catalyzed mixture and mixed in a manner to achieve a homogenous blend.
4. The topping shall be applied over horizontal surfaces using a pin rake, trowels or other systems approved by the Manufacturer. Spread rate per kit is 32 sq. ft.
5. Immediately upon placing, the topping shall be degassed with a 15/16 inch spiked roller.

6. The finish floor will have a nominal thickness of 3/16 mils.

3.4 FIELD QUALITY CONTROL

A. Quality Control by Installer: The following monitoring shall be performed.

1. Temperature: Air, substrate temperatures, relative humidity, and, if applicable, dew point.
2. Coverage Rates: Rates for all layers shall be monitored by checking quantity of material used against the area covered.

B. Material Sampling: The District may, at any time and any number of times during resinous flooring installation, require material samples for testing for compliance with requirements.

1. The District will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified in presence of Contractor.
2. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.
3. If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reinstall flooring materials to comply with requirements.

3.5 PROTECTION

A. Cure flooring material in compliance with manufacturer’s directions.

B. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

END OF SECTION 096723

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:
   1. All-natural 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. Shop Drawings: Show location and extent of each wall-covering type. Indicate seams and termination points.

C. Samples: For each type of wall covering and for each color, pattern, texture, and finish specified, full width by 36 inches (914 mm) long in size.

   1. Wall-Covering Sample: From same production run to be used for the Work, with specified treatments applied.
   2. Include sample of central joint.

D. Product Schedule: For wall coverings. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. 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 production 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. 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 F1141 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 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 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 ALL-NATURAL WALL COVERING

A. Basis of Design: Laminart Super Organic (Oberflex).

B. Description: Provide wallcovering in rolls from same production run.

C. Width: 3070 mm x 1300 mm (120 inches x 50 inches).

D. Repeat: **Random**

E. Features:
1. Flowers, botanicals and plant fibers adhered to flax backing.

F. Colors, Textures, and Patterns: Refer to Finish Schedule in the drawings.

2.2 ACCESSORIES

A. Adhesive: Mildew-resistant, nonstaining**, strippable** adhesive, for use with specific wall covering and substrate application indicated and as recommended in writing by wall-covering manufacturer.

B. Substrate Primer/Sealer: Mildew resistant, recommended in writing by primer/sealer and wall-covering manufacturers for intended substrate.

C. Surface Sealer: 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 installation surfaces being true in plane and vertical and horizontal alignment, maximum moisture content, and other conditions affecting performance of the Work.
1. Appropriate level of drywall finish.

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, and mildew.

C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.

1. Moisture Content: Maximum of 5 percent on new plaster, concrete, and concrete masonry units when tested with an electronic moisture meter.
2. Gypsum Board: Apply primer/sealer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
3. Painted Surfaces:

    a. Check for pigment bleeding. Apply primer/sealer to areas susceptible to pigment bleeding as recommended in writing by primer/sealer manufacturer.
    b. Sand gloss, semigloss, and eggshell finishes with fine sandpaper.

D. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

E. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

3.3 INSTALLATION OF WALL COVERING

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 wall covering without lifted or curling edges and without visible shrinkage.

D. Install seams vertical and plumb at least 6 inches (152 mm) from outside corners and 6 inches (152 mm) from inside corners unless a change of pattern or color exists at corner. Horizontal seams are not permitted.

E. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without overlaps or gaps between strips.

F. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.

G. Apply specified finish system according to coating manufacturer's written instructions to produce finish that is consistent in color and gloss.

H. Apply no fewer than **two** finish coats.

3.4 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 097713 – STRETCHED-FABRIC WALL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Stretched-fabric wall system.

B. Related Sections:
1. Section 064023 "Interior Architectural Woodwork" for wood trim related to stretched-fabric wall system.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For panel, fabric, accessories and installation.

C. Samples: For each exposed product and for each color and texture specified.
1. Initial Samples: Submit 3 samples.
a. Each frame profile: 12" minimum length.
b. Each fabric.
c. Wood trim for frame.
2. Samples for verification: Submit 3 samples.
a. Minimum 24 inch by 24 inch assembly including wood frame and any internal joints.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of panel.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of panel to include in maintenance manuals. Include fabric manufacturers' written cleaning and stain-removal instructions.

1.5 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. Fabric: For each fabric, color, and pattern installed, furnish length equal to 10 percent of amount installed, but no fewer than 10 sq. yd., full width of bolt.

2. Framing and Related Installation Items: Furnish manufacturer's full-length units equal to 5 percent of amount installed, but no fewer than five units.

1.6 WARRANTY

A. Special Warranty: Manufacturer and Installer agree to repair or replace components of stretched-fabric systems that fail in performance, materials, or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
a. Acoustical performance.
b. Fabric sagging, distorting, or releasing from panel edge.
c. Warping of core.
2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: Panels shall comply with "Surface-Burning Characteristics" or "Fire Growth Contribution" Subparagraph below, or both, as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
1. Surface-Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 450 or less.
2. Fire Growth Contribution: Comply with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265 Method B Protocol or NFPA 286.

2.2 STRETCHED-FABRIC WALL SYSTEM

A. Fabric-Wrapped Wall Panel: Manufacturer's standard panel construction consisting of core board, edge profiles and facing material.
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Finish Schedule.
2. Core: Manufacturer's standard, complying with NRC requirements indicated.
3. Edge Profiles: As indicated on Drawings.
4. Facing Material: As indicated on Drawings.
5. Nominal Overall Panel Thickness: As indicated on Drawings.
6. Wood Frame: As indicated on the Drawings.

2.3 MATERIALS

A. Core Materials: Manufacturer's standard.

B. Facing Material: Fabric from same dye lot; color and pattern as selected by Architect from manufacturer's full range.

2.4 FABRICATION

A. Facing Material: Apply fabric fully covering visible surfaces of panel; with material stretched straight, on the grain, tight, square, and free from puckers, ripples, wrinkles, sags, blisters, seams, adhesive, or other visible distortions or foreign matter.
   1. Fabrics with Directional or Repeating Patterns or Directional Weave: Mark fabric top and attach fabric in same direction so pattern or weave matches in adjacent panels.

B. Dimensional Tolerances of Finished Panels: Plus or minus 1/16 inch.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panels in locations indicated. Unless otherwise indicated, install panels with vertical surfaces and edges plumb, top edges level and in alignment with other panels, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.

B. Comply with manufacturer's written instructions for installation of panels using type of mounting devices indicated. Mount panels securely to supporting substrate.

C. Align fabric pattern and grain with adjacent panels.

3.2 CLEANING

A. Clip loose threads; remove pills and extraneous materials.

B. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

END OF SECTION

SECTION 098100 - ACOUSTIC INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Acoustic blanket insulation.

B. Related Sections:
1. Section 092216 “Non-Structural Metal Framing" for furring channels, resilient sound isolation clips and accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:
1. Laboratory Test Reports: For insulation, indicating compliance with requirements for low-emitting materials.

1.3 QUALITY ASSURANCE

A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

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 E119 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 E90 and classified according to ASTM E413 by an independent testing agency.

C. Sustainable Design Performance Requirements:
1. Insulation shall comply with the following:
a. Low-Emitting Materials: Testing and product requirements of the California Department of Health Services CDPH Standard Method v1.1, using CA Section 01350, Appendix B, New Single-Family Residence Scenario.

2.2 ACOUSTIC INSULATION

A. Acoustic Blankets: 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.
   1. Thickness:
      a. Partitions: As required to fill cavity.
      b. Above Suspended Ceilings: 10 inches, unless otherwise indicated.
   2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Partitions:
         1) Owens Corning; Sound Attenuation Batts.
         2) Johns Manville; Sound Control Batts.
      b. Above Suspended Ceilings:
         1) Owens Corning; Sonobatts.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

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. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness.

E. 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 wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by attaching flanges of insulation to flanges of studs.
   5. Where acoustic blankets are indicated for sound attenuation above ceilings, install acoustic blanket insulation over entire ceiling area in thicknesses indicated.

END OF SECTION

SECTION 099100 – PAINTING AND COATING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and the application of paint systems on interior and exterior substrates

B. Related Sections:
1. Division 05 Sections for shop-priming of metal substrates with primers specified in this Section.
2. Section 056000 "Landscape Metal Fabrications."
3. Section 329300 "Landscape Planting" for landscape edging

1.2 DEFINITIONS

A. Sheen Levels:
1. Flat: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
2. Eggshell: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
3. Satin: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
4. Semi-Gloss: 35 to 70 units at 60 degrees, according to ASTM D 523.
5. Gloss: 70 units and greater at 60 degrees, according to ASTM D 523.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

B. Sustainable Design Submittals:
1. Laboratory Test Reports: For paints and coatings, indicating compliance with requirements for low-emitting materials.

C. Samples: For each type of paint system and in each color and gloss of topcoat.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide product listed in the schedules in Part 3 for the paint category indicated.

2.2 PERFORMANCE REQUIREMENTS

A. Sustainable Design Performance Requirements:
   1. Paints and coatings shall comply with the following:
      a. Low-Emitting Materials: Testing and product requirements of the California Department of Health Services CDPH Standard Method v1.1, using CA Section 01350, Appendix B, New Single-Family Residence Scenario.

2.3 PAINT, GENERAL

A. 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.

B. Paint Colors: As indicated in a color schedule. Submit color samples to Owner's Representative for approval.

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. Fiber-Cement Board: 12 percent.
   3. Wood: 15 percent.
   4. Gypsum Board: 12 percent.
   5. Plaster: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Plaster Substrates: Verify that plaster is fully cured.

E. Spray-Textured Ceiling Substrates: Verify that surfaces are dry.

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 if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
   1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
   1. SSPC-SP 3, "Power Tool 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:
   1. Metal Substrates Galvanized in Accordance with ASTM A 123 and ASTM A 153: Prepare substrates in accordance with ASTM D 6386.
   2. Other Galvanized Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

H. Aluminum Substrates: Remove loose surface oxidation.

I. Wood Substrates:
   1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
   2. Sand surfaces that will be exposed to view, and dust off.
   3. Prime edges, ends, faces, undersides, and backsides of wood.
   4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

J. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

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. For items that are factory primed, apply tinted base primer and one cover for the interior. For exterior pre-primed siding, use two coats to cover. For plaster primer one coat to cover.

B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

C. 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.

D. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
   1. Paint the following work where exposed in equipment rooms:
      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. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
   2. Paint the following work where exposed in occupied spaces:
      a. Equipment, including panelboards.
      b. Uninsulated metal piping.
      c. Uninsulated plastic piping.
      d. Pipe hangers and supports.
      e. Metal conduit.
      f. 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.
   3. 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. 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.

B. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. Gypsum Board; Acrylic Latex: Provide one of the following systems:
   1. Benjamin Moore:
      a. Primer: Ultra Spec 500 Interior Latex Primer.
      b. Intermediate Coat: Same as top coat.
      c. Top Coat: Ultra Spec 500 Interior.
      d. Sheen:
         1) Walls: Satin, unless indicated otherwise.
         2) Ceilings: Flat, unless indicated otherwise.

B. Wood Trim, Wood Doors, Wood Frames and Other Interior Wood and Wood-Based Items as Indicated; Acrylic Latex. Provide one of the following systems:
   1. Benjamin Moore:
      a. Primer: Ultra Spec 500 Interior Latex Primer.
      b. Intermediate Coat: Same as top coat.
      c. Top Coat: Advance Waterborne Interior Alkyd.
      d. Sheen: Satin, unless indicated otherwise.

C. Ferrous and Non Ferrous Metals Including: Exposed metal fabrications, steel doors, steel door frames, grilles, panels, stairs, railings, and other miscellaneous metal items indicated; Direct to Metal Acrylic. Provide one of the following systems:
   1. Rustoleum Sierra Performance:
      a. Primer: S-37 System Metalmax DTM Acrylic Urethane.
      b. Intermediate Coat: None required.
      c. Top Coat: Same as Primer.
      d. Sheen: Semi-gloss, unless indicated otherwise.
   2. Sherwin Williams:
      a. Primer: Pro Industrial Acrylic Semi-Gloss B66-650 Series.
      b. Intermediate Coat: None required.

c. Top Coat: Same as Primer.
d. Sheen: Semi-gloss, unless indicated otherwise.

3. PPG:
a. Primer: 90-1210 Pitt-Tech Plus Int / Ext Semi-gloss DTM Enamel.
b. Intermediate Coat: None required.
c. Top Coat: Same as Primer.
d. Sheen: Semi-gloss, unless indicated otherwise.

D. Concrete; Acrylic Latex: Provide one of the following systems:
1. Benjamin Moore:
a. Primer:
1) Concrete: Super Spec Masonry Interior/Exterior 100% Acrylic Masonry Sealer N/066.
b. Intermediate Coat: Same as top coat.
c. Top Coat: Ultra Spec 500 Interior.
d. Sheen: Eggshell, unless indicated otherwise.

E. Mechanical and Electric Equipment Items: Provide one of the following systems:
1. Tnemec:
a. One Coat: Uni-Bond DF Series 115; 3.0 DFM.
b. Color: White, unless indicated otherwise.
2. PPG:
a. One Coat: Speedhide Super Tech Interior Dry Fog Flat 6-723XI.
b. Color: White, unless indicated otherwise.

3.7 EXTERIOR PAINTING SCHEDULE

A. Ferrous Metal: Exposed steel members, bollards, landscape fabrications, landscape edging, exposed miscellaneous metal; Urethane. Provide the following system:
1. Tnemec:
a. Primer: Mio-zinc urethane; 394 PerimePrime, 2.5 to 3.5 DFM.
b. Intermediate Coat: Polyamidoamine epoxy; Series L69 Hi-Build Epoxoline II, 4 to 6 DFM.
c. Top Coat: Acrylic polymer; Series 1029 Enduratone, 2 to 4 DFM.
d. Sheen: Semi-gloss.

B. Galvanized Metal: Exposed structural steel members, hollow metal doors and frames, railings, bollards, canopy framing, exposed miscellaneous metal; Urethane. Provide the following system:
1. Tnemec:
a. Primer: Polyamidoamine epoxy, Series L69, 4 to 6 DFM.
b. Intermediate Coat: Not required.
c. Top Coat: Acrylic polymer; Series 1029 Enduratone; 2 to 4 DFM.
d. Sheen: Semi-gloss.

C. Stainless steel; Alkyd. Provide one of the following systems:
1. Benjamin Moore:
a. Primer: Super Spec Alkyd Metal Primer.
b. Intermediate Coat: Same as topcoat.
c. Top Coat: Super Spec Alkyd Enamel.

d. Sheen: Semi-gloss.

D. Concrete: Modified Waterborne Acrylate. Provide the following system:
1. Tnemec:
a. Primer: Waterborne modified polyamine epoxy, 151-1051 Elasto-Grip FC, 6 mils.
b. Intermediate Coat: Not required.
c. Top Coat: High build acrylic; Enviro-Crete; 9 DFM.
d. Sheen: Flat.

E. Exterior Wood Siding and Trim; Acrylic latex. Provide one of the following systems:
1. Benjamin Moore:
a. Primer: Super Spec Busan Acrylic Exterior Primer.
b. Intermediate Coat: Same as topcoat.
c. Top Coat: Ultra Spec EXT.
d. Sheen: Satin.

END OF SECTION

SECTION 099300 - STAINING AND TRANSPARENT FINISHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Primers
2. Wood stains.
3. Transparent finishes.

B. Related Requirements:
1. Section 033543 "Polished Concrete Finishing" for transparent high-performance coatings on concrete floors.
2. Section 061719 “Cross Laminated Timber.”
3. Section 061800 “Glued-Laminated Construction.”
4. Section 064013 “Exterior Architectural Woodwork.”
5. Section 064023 “Interior Architectural Woodwork.”
6. Section 099100 “Paintings & Coatings.”

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.
2. Include preparation requirements and application instructions.
3. Indicate VOC content.

B. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of exposed finish.

C. Samples for Verification: Sample for each type of finish system and in each color and gloss of finish required on representative samples of actual wood substrates.

1. Size: 8 inches (200 mm) 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.
5. Provide samples for a range of saturations for custom stain pigment.
    a. Specified pigment level.
    b. 2/3 Specified pigment level.
    c. 4/3 specified pigment level.

d. No pigment.

D. Product List: Cross-reference to finish system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.3 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Stains and Transparent Finishes: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.4 MOCKUPS

A. Apply mockups of each finish system indicated and each color selected to verify preliminary selections made under Sample submittals.

1. Architect will select one surface to represent surfaces and conditions for application of each type of finish system and substrate.

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.

3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.6 FIELD CONDITIONS

A. Apply finishes only when temperature of surfaces to be finished and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply finishes when relative humidity exceeds 85 percent, at temperatures of less than 5 deg F (3 deg C) above the dew point, or to damp or wet surfaces.

C. Do not apply exterior finishes in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Source Limitations: Obtain each coating product from single source from single manufacturer.
   1. Provide products from Basis of Design manufacturer, or approved equivalent:
      a. The Sansin Corporation.

2.2 MATERIALS, GENERAL

A. Material Compatibility:

   1. Provide materials for use within each coating 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.

B. Stain Colors: White, refer to wood-finish-system schedules at end of this specification.

2.3 TRANSPARENT FINISHES

A. Varnish, Exterior, Water Based,: Water-based clear varnish for exterior wood surfaces.

B. Varnish, Interior, Water Based, Clear: Water-based clear coating for interior wood surfaces.

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 Exterior Wood Substrates: 15 percent, when measured with an electronic moisture meter.

C. Maximum Moisture Content of Interior Wood Substrates: 10 percent, when measured with an electronic moisture meter.

D. Verify suitability of substrates, including surface conditions and compatibility with finishes and primers.

E. 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. 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, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

B. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each substrate condition and as specified.

1. Remove dust, dirt, oil, and 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.

C. Exterior Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.

2. Countersink steel nails, if used, and fill with putty or plastic wood filler tinted to final color. Sand smooth when dried.

D. Interior Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Apply wood filler paste to open-grain woods to produce smooth, glasslike finish.
3. Sand surfaces exposed to view and dust off.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dry.

3.3 APPLICATION

A. Apply finishes according to manufacturer's written instructions.

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 CLEANING AND PROTECTION

A. At end of each 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.

3.5 EXTERIOR WOOD-FINISH-SYSTEM SCHEDULE

A. Wood Substrates, Glued-Laminated Construction:

1. Water-Based Varnish System:

a. Prime Coat: Sansin KP-40.
b. Intermediate Coat: KP-52 Gloss with 16 parts white pigment.
c. Topcoat: KP-52 Satin with 6 parts white pigment.

B. Wood Substrates, CLT:

1. Water-Based Varnish System:

a. Prime Coat: Sansin KP-40.
b. Intermediate Coat: KP-52 Gloss with 16 parts white pigment.
c. Topcoat: KP-52 Satin with 6 parts white pigment.

C. Wood Substrates, Exposed Framing:

1. Water-Based Varnish System:

a. Prime Coat: Sansin KP-40.
b. Intermediate Coat: KP-52 Gloss with 16 parts white pigment.
c. Topcoat: KP-52 Satin with 6 parts white pigment.

D. Wood Substrates, Wood Board Siding:

1. Water-Based Varnish System:

a. Prime Coat: Sansin KP-40.
b. Intermediate Coat: KP-52 Gloss with 16 parts white pigment.
c. Topcoat: KP-52 Satin with 6 parts white pigment.

E. Wood Substrates, Site-Fabricated Wood Seating:

1. Water-Based Varnish System:

a. Prime Coat: Sansin KP-40.
b. Intermediate Coat: KP-52 Gloss with 16 parts white pigment.
c. Topcoat: KP-52 Satin with 6 parts white pigment.

3.6 INTERIOR WOOD-FINISH-SYSTEM SCHEDULE

A. Wood Substrates, Glued-Laminated Construction:

1. Water-Based Varnish System:

a. Prime Coat: PC Purity Glacier Gloss.
b. Topcoat: PC Purity Glacier Satin.

B. Wood Substrates, CLT:

1. Water-Based Varnish System:

a. Prime Coat: PC Purity Glacier Gloss.
b. Topcoat: PC Purity Glacier Satin.

C. Wood Substrates, Exposed Framing:

1. Water-Based Varnish:

a. Prime Coat: PC Purity Glacier Gloss.
b. Topcoat: PC Purity Glacier Satin.

D. Wood Substrates, Architectural Woodwork:

1. Water-Based Varnish System:

a. Prime Coat: PC Purity Glacier Gloss.
b. Topcoat: PC Purity Glacier Satin.

E. Wood Substrates, Wood Board Siding:

1. Water-Based Varnish System:

a. Prime Coat: PC Purity Glacier Gloss.
b. Topcoat: PC Purity Glacier Satin.

END OF SECTION 099300

SECTION 101100 - VISUAL DISPLAY UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Visual display board assemblies.

B. Related Sections:
1. Section 064023 "Interior Architectural Woodwork" for tackboard frames.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:
1. Laboratory Test Reports: For installation adhesives, indicating compliance with requirements for low-emitting materials.

C. Shop Drawings: For visual display units.
1. Include plans, elevations, sections, details, and attachment to other work.
2. Show locations of panel joints

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For visual display units to include in maintenance manuals.

1.4 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install visual display units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

B. Build mockup of **VDU-1** to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
1. Location: As approved 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.

1.5 WARRANTY

A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Surfaces lose original writing and erasing qualities.
      b. Surfaces exhibit crazing, cracking, or flaking.
   2. Warranty Period:
      a. 50 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sustainable Design Performance Requirements:
   1. Installation Adhesives: Comply with the following:
      a. Low-Emitting Materials: Testing and product requirements of the California Department of Health Services CDPH Standard Method v1.1, using CA Section 01350, Appendix B, New Single-Family Residence Scenario.

B. Surface-Burning Characteristics: Comply with ASTM E84; 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.

2.2 VISUAL DISPLAY BOARDS

A. Visual Display Board Assembly **VDU-2**: Bulletin Board (pinboard).
   1. Basis-of-Design Product: As indicated on Drawings and Finish Schedule.
      a. Frame: Refer to 064023 "Interior Architectural Woodwork."

B. Visual Display Board Assembly **VDU-1**: Marker Board.
   1. Basis-of-Design Product: As indicated on Drawings and Finish Schedule.
      a. Frame: Refer to 064023 "Interior Architectural Woodwork."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display units and wall surfaces.

B. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines

straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

C. Factory-Fabricated Visual Display Board Assemblies: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display board assemblies with fasteners at not more than 16 inches o.c. Secure tops and bottoms of boards to walls.

END OF SECTION

SECTION 101400 - SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes but is not limited to: ADA and CBC Chapter 11B code compliant photopolymer signs with raised Braille/tactile graphics; porcelain enamel; all supplementary parts and components, hardware, mounting adhesives or other miscellaneous supports and materials required for a complete and thorough installation.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Submittal Procedures:

1. Action Submittals shall be submitted in accordance with Division 01.

1.3 ACTION SUBMITTALS

A. Shop Drawings: Submit complete signage program, message schedule, and shop drawings showing locations and details of sign construction, color, type size, and style of letters, sizes of signs, and anchoring details.

B. Product Data: Manufacturer's literature including general specifications, sign materials, finishes, colors, features, construction, and installation instructions. Submit data from the manufacturer to certify recycled content of materials, manufacture location and harvest location (i.e. cut sheets, and/or manufacturer certification letters).

C. Samples and Mockups: Submit full size samples for approval:

1. 6"x6" paint sample indicating color and finish for each color specified.

1.4 QUALITY ASSURANCE

A. Furnish products of a single manufacturer to ensure signage is of a uniform quality, appearance and color.

B. Obtain materials for systems from either a single manufacturer or from manufacturer approved by systems manufacturer to ensure quality of appearance and performance.

C. Select materials that have the highest possible recycled content while still meeting performance criteria. Select materials from local manufacturers wherever possible.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Neiman & Co. (818) 781-8600

B. Ampersand Contract Signing Group (323) 255-5311

C. TFN Architectural Signage (714) 755-4108

D. (Or Equal)

2.2 MATERIALS AND FABRICATION

A. Raised / etched graphics: Lettering shall be tactile via photomechanical resist and chemical etching. Etched images shall be at least 1/32" deep and shall not exceed 3/64" depth in order to keep tactile and Braille lettering legible and compliant with ADA standards.

B. Braille text: Photochemically reproduce Grade 2 Braille letters by etching background to a depth of 1/32" minimum and no deeper than 3/64" overall. Braille letters shall be smooth and rounded upon the face of the dots and shall be acceptable for tactile reading.

C. Edge finish: All visible edges shall be painted with polyurethane paint as indicated in drawings. Saw marks, kerfs, rough or uneven edges shall be unacceptable. Edges shall be precision machined and visually smooth. Panels shall be perfectly matched to mounting panels (when a mounting panel is required).

D. Pin-mount supports shall be 3/16" diameter stainless steel threaded rods as appropriate.

E. Provide non-corrosive fasteners and mounting devices. For interior signs, provide vandal resistant screws, pressure sensitive double-sided VHB tape, and silicone as required. For exterior signs provide tamper-proof fasteners.

F. Exterior signs: 0.125 inch aluminum with screen printed copy or raised characters and Grade 2 Braille.

G. Provide non-corrosive fasteners, hangers, and mounting devices that are compatible with sign material and finish. For interior signs provide double-sided VHB adhesive foam tape. For exterior signs provide secure tamperproof fasteners.

H. Related Materials: Other materials, not specifically described but required for a complete and proper installation of sign, shall be as approved by University's Representative.

I. Applied graphics: All painted, printed and fabricated finishes to be smooth, free of scratches, gouges, air bubbles, foreign matter or other imperfections.

J. All applied vinyl graphics to be smooth, free of scratches, gouges, air bubbles, foreign matter or other imperfections.

K. Screen printed graphics: Apply copy and graphics to substrates using the photographic screen printing process using pre-tested compatible paints and inks only. All screen-printed images shall be of high resolution with smooth edges free from nicks or saw tooth edges. Inks and paints shall be colorfast, permanent and have compatible adhesion to specified substrates. Durability of applied graphics shall be five years minimum (under normal conditions).

L. Letterforms and symbols shall be photographically precise, crisp, clean and free of ticks, discontinuous curves, free of line waves, cut or ragged edges, edge build-up, bleeding surface pinholes, and other imperfections. Letterforms shall conform to the prescribed letterform proportions.

M. Unless otherwise indicated, letterforms shall be aligned to maintain a baseline parallel to the sign format.

N. All lettering applications shall utilize, except where specified, typefaces designated for sign lettering on this project. A sample of the typefaces will be made available by the University's Representative. The Contractor must purchase copies of the fonts from the type foundry. This procedure complies with copyright laws and current standards. Layout proofs will be submitted by the Contractor to the University's Representative via shop drawings for approval and sign-off.

O. All typography shall match intended scaled drawing layouts. Actual sign copy shall be as shown in the Message Schedule. Emergency equipment and evacuation symbols (for life safety evacuation maps, where used) shall be relocated and graphically repositioned as necessary for each unique map location. Verify copy and symbol locations with University's Representative prior to fabrication or installation of any signs.

P. Significant typographic changes from examples shown herein shall be brought to the attention of the University's Representative.

2.3 SIGN TYPES

A. Room & space id
B1 Student room id (tactile)
B2 Room id (tactile)

B. Code information
C1 Exit (tactile)
C2 Stair level indicator (tactile)
C3 Stair id (tactile)
C4 Elevator emergency sign (tactile)
C5 Evacuation map
C6 Restroom – wall (tactile)
C7 Restroom – door
C8 ISA at entries
C9 No smoking at entries
C10 Area of refuge
C11 2 way communication device (tactile)
C12 Maximum occupancy signage

C. Directional
D1 Accessibility directional – wall

D. Miscellaneous
E1 Occupancy
E2 Vending id
E3 Mail box id
E4 Mail box instructions
E5 Multi-purpose id
E6 Laundry app instructions

E. Fire department
F1 Fire sprinkler & fd connection
F2 Fire sprinkler valve id

F3 Fire extinguisher id
F4 Standpipe hose connection
F5 Fire lane information
F6 Fire system water entry room

PART 3 - EXECUTION

3.1 EXAMINATION

A. Inspect all surfaces to receive signage and report all defects that would interfere with signage installation.

B. Starting work implies acceptance of surfaces as satisfactory.

C. Verify all conditions and sign dimensions in field. Contractor to review and study architectural, and all related plans to insure that all proposed signs can be installed and supported. Verification of conditions and sign dimensions to be completed prior to sign fabrication and reviewed with the Designer.

D. Verify if anti-graffiti coating may be required for signage with a high degree of exposure to pedestrian traffic.

3.2 INSTALLATION

A. Special Precautions: Guard against damaging existing pavements and planting where signage is to be installed.

B. Footings beneath topping surface shall be installed and located prior to top surface installation.

C. Prior to installation, check all components, nuts, bolts, and other connections for proper alignment, fit and any damage. Replace damaged or defective components.

D. Install all signs plumb, level, square and rigidly secured.

E. Do not install any signs that are defective or damaged.

F. Wet environments: Check to see if irrigation might discolor sign faces or erode foundations.

G. Use all means necessary to protect materials before, during and after installation.

3.3 ADJUSTMENTS

A. After installation, review conditions and fix or replace any defective or poorly installed signs.

END OF SECTION

SECTION 102600 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Corner guards.
2. Wall protection at trash termination room.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:
1. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sustainable Design Performance Requirements:
1. Adhesives: Comply with the following:
a. Low-Emitting Materials: Testing and product requirements of the California Department of Health Services CDPH Standard Method v1.1, using CA Section 01350, Appendix B, New Single-Family Residence Scenario.

2.2 CORNER GUARDS

A. Surface-Mounted, Vinyl Corner Guards: Fabricated as one piece from rubber; with formed edges; fabricated with 90- or 135-degree turn to match wall condition.
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. Activar Construction Products Group, Inc.
b. American Floor Products Company, Inc.
c. Babcock-Davis.
d. Boston Retail Products.
e. Construction Specialties, Inc.
f. Inpro Corporation.
g. Korogard Wall Protection Systems; a division of RJF International Corporation.
h. Musson Rubber Co.
i. Nystrom.

j. Pawling Corporation.
k. Tepromark International, Inc.
l. WallGuard.com.
m. wallProtex.

2. Mounting: Adhesive.
3. Color and Texture: As selected by Architect from manufacturer's full range to match adjacent finishes.

2.3 WALL PROTECTION

A. Wall Panel
1. Material: Diamond Plate Stainless Steel – 4 foot wide and 8 foot tall.
a. Basis of Design Manufacturer: INPRO Architectural Products
2. Corner Panel: Bend minimum 2 inches.

2.4 MATERIALS

A. Adhesive: As recommended by protection product manufacturer.

2.5 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 and door protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
1. For wall and door protection attached with adhesive, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Complete finishing operations, including painting, before installing wall and door protection.

B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

A. Installation Quality: Install wall and door 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. Mounting Heights: Install wall and door protection in locations and at mounting heights indicated on Drawings.

C. 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.

3.4 CLEANING

A. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION

SECTION 102800 - TOILET, BATH, AND CUSTODIAL ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Toilet and bath accessories.
a. ADA and CBC Chapter 11B code compliant.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
1. Identify locations using room designations indicated.
2. Identify accessories using designations indicated.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For accessories to include in maintenance manuals.

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. Structural Performance:
1. Grab Bars: Installed units are able to resist 250 lbf concentrated load applied in any direction and at any point.
2. Shower Seats: Installed units are able to resist 250 lbf applied in any direction and at any point.

2.2 TOILET AND BATH ACCESSORIES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product scheduled on Drawings.

2.3 CUSTODIAL ACCESSORIES

A. Locations: Install one set at each Janitorial Room.

B. Source Limitations: Obtain custodial accessories from single source from single manufacturer.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. ASI-American Specialties, Inc.
      b. Bobrick Washroom Equipment, Inc.
      c. Bradley Corporation
      d. Brey-Krause Manufacturing Co.
      e. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.
      f. Tubular Specialties Manufacturing, Inc.

C. Custodial Utility Shelf:
   1. Description: With exposed edges turned down not less than 1/2 inch and supported by two triangular brackets welded to shelf underside.
   2. Size: 16 inches long by 6 inches deep.
   3. Material and Finish: Not less than nominal 0.05-inch- thick stainless steel, ASTM A480/A480M No. 4 finish (satin).

D. Custodial Mop and Broom Holder:
   1. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
   2. Length: 36 inches.
   3. Hooks: Four.
   4. Mop/Broom Holders: Three, spring-loaded, rubber hat, cam type.
   5. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
      a. Shelf: Not less than nominal 0.05-inch- thick stainless steel.
      b. Rod: Approximately 1/4-inch- diameter stainless steel.

2.4 FABRICATION

A. 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.
   1. Remove temporary labels and protective coatings.

B. Grab Bars: Install to comply with specified structural-performance requirements.

C. Shower Seats: Install to comply with specified structural-performance requirements.

END OF SECTION

SECTION 104400 - FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Fire-protection cabinets for portable fire extinguishers.
      a. Rated fire-protection cabinets for portable fire extinguishers.
   2. Portable, hand-carried fire extinguishers.
   3. Key lock boxes.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For fire-protection cabinets.

1.3 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire protection specialties to include in maintenance manuals.

1.5 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Failure of hydrostatic test according to NFPA 10 when testing interval required by NFPA 10 is within the warranty period.
      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. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E814 for fire-resistance rating of walls where they are installed.

B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

C. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

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. Babcock-Davis.
      b. Fire-End & Croker Corporation.
      c. GMR International Equipment Corporation.
      d. Guardian Fire Equipment, Inc.
      e. JL Industries, Inc.; a division of the Activar Construction Products Group.
      f. Larsens Manufacturing Company.
      g. Modern Metal Products, Division of Technico Inc.
      h. MOON American.
      i. Nystrom.
      j. Potter Roemer LLC; a Division of Morris Group International.
      k. Strike First Corporation of America (The).

B. Cabinet Construction: **Match rating of partitions where cabinets are located**.
   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: Cold-rolled steel sheet.

D. Recessed Cabinet:
   1. Trimless with Hidden Flange: Flange of same metal and finish as box overlaps surrounding wall finish and is concealed from view by an overlapping door.

E. Door Material: Steel sheet.

F. Door Style: Solid opaque panel with frame.

G. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

H. Accessories:

1. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by Architect.

I. Materials:
1. Cold-Rolled Steel: ASTM A1008/A1008M, Commercial Steel (CS), Type B.
   a. Finish: Baked enamel, TGIC polyester powder coat, HAA polyester powder coat, epoxy powder coat, or polyester/epoxy hybrid powder coat, complying with AAMA 2603.
   b. Color: White.

J. FABRICATION
1. 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.

2.3 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Amerex Corporation.
   b. Ansul by Johnson Controls Company.
   c. Babcock-Davis.
   d. Badger Fire Protection.
   e. Buckeye Fire Equipment Company.
   f. Fire End & Croker Corporation.
   g. Guardian Fire Equipment, Inc.
   h. JL Industries, Inc.; a division of the Activar Construction Products Group.
   i. Kidde Residential and Commercial Division.
   j. Larsens Manufacturing Company.
   k. MOON American.
   l. Nystrom.
   m. Potter Roemer LLC; a Division of Morris Group International.
   n. Pyro-Chem; Tyco Fire Suppression & Building Products.
   o. Strike First Corporation of America (The).
2. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.
3. Wall-mounting clip: manufacturer’s standard, stainless steel.

B. Multipurpose Dry-Chemical Type: UL-rated 3-A:40-B:C, 5-lb nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.

2.4 KEY LOCK BOXES

A. Key Lock Boxes: Designed for storage of keys.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Knox Company.
2. Color: As selected by architect from manufacturer's standard range.

PART 3 - EXECUTION

3.1 INSTALLATION OF CABINETS

A. Prepare recesses for recessed fire-protection cabinets as required by type and size of cabinet and trim style.

B. Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.

C. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.

D. Identification: Apply at locations indicated.

E. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

3.2 INSTALLATION OF EXTINGUISHERS

A. Examine fire extinguishers for proper charging and tagging.
1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Install fire extinguishers in locations indicated and in compliance with requirements of authorities having jurisdiction.

3.3 INSTALLATION OF KEY LOCK BOXES

A. Examine walls for suitable framing depth and blocking where key lock boxes will be installed and prepare recesses as required by type and size of lock box and trim style.

B. Install key lock boxes in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.

END OF SECTION

SECTION 105500.13 - POSTAL SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Mail receptacles.
2. Smart parcel lockers. (Owner-furnished, Owner-installed, blocking, power and data connections by Contractor)

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For postal specialties. Include plans, elevations, sections, and attachment details.

C. Samples: For each type of exposed finish.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of postal specialty required to comply with USPS regulations, signed by product manufacturer. Include written approval by Postmaster General.

B. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For postal specialties and finishes to include in maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Furnish lock keys according to USPS requirements; with temporary identification for their respective locks, bagged, and securely taped inside the collection compartment for shipping.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of postal specialties 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 MAIL RECEPTACLES

A. Front-Loading Mail Receptacles: USPS-STD-4C; consisting of multiple compartments with fixed, solid compartment backs, enclosed within a recessed wall box.
   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. Salsbury Industries.
   2. Front-Loading Master Door: Fabricated from extruded aluminum and braced and framed to hold compartment doors; prepared to receive master-door lock.
      a. Master-Door Lock: Door prepared to receive lock provided by local postmaster.
   3. Compartments: As indicated on Drawings, of the following sizes:
      a. Type III: A group of mail receptacles in double-column configuration with single master door, mail compartments not less than 3 inches high by 12 inches wide by 15 inches deep, one outgoing mail collection compartment prepared for master-door lock, and two parcel-locker compartment(s): 18 inches high by 12 inches wide by 15 inches deep.
   4. Compartment Doors: Fabricated from extruded aluminum. Equip each with lock and tenant identification as required by USPS-STD-4C. Provide mail slot in the compartment with master-door lock.
      a. Compartment-Door Locks: USPS-L-1172C; with three keys for each compartment door.
      b. Parcel-Locker-Compartment-Door Locks: Two-key security system in which control key provides access to parcel-locker-compartment key, which opens compartment and is retained once opened.
   5. Frames: Extruded aluminum or aluminum sheet; ganged and nested units, with cardholder and blank cards for tenant's identification within each compartment.
   6. Concealed Components and Mounting Frames: Aluminum or steel sheet.
   7. Exposed Aluminum Finish: Bronze anodized.

B. SMART PARCEL LOCKERS (Owner-furnished, Owner-installed)
   1. Basis of Design: LUXER ONE TOWER SERIES, or equal.
      a. Provide power and data connections for lockers and surveillance camera.
      b. Size and location: as indicated in the drawings.
      c. Configuration: as selected by Owner.

2.2 FABRICATION

A. Form postal specialties to required shapes and sizes, with true lines and angles, square, rigid, and without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges and corners free of sharp edges and burrs and safe to touch. Fabricate doors of postal specialties to preclude binding, warping, or misalignment.

B. Preassemble postal specialties in shop to greatest extent possible to minimize field assembly.

C. Mill joints to a tight, hairline fit. Cope or miter corner joints. Form joints exposed to weather to exclude water penetration.

D. Where dissimilar metals contact each other, protect against galvanic action by painting contact surfaces with bituminous coating or by applying other permanent separation as recommended by manufacturers of dissimilar metals.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mail Receptacles: Install mail receptacles with center of tenant-door lock cylinders and bottom of compartments at the maximum and minimum heights above finished floor established by the USPS and manufacturer's written instructions.

3.2 FIELD QUALITY CONTROL

A. Arrange for USPS personnel to examine and test postal specialties served by the USPS after they have been installed according to USPS regulations.

END OF SECTION

SECTION 107113.43 – SUN SHADES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Modular, shop fabricated sun shades to be mounted on structure.

1.2 REFERENCE STANDARDS

A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum 2014 (2015 Errata).

B. AAMA 612 - Voluntary Specification, Performance Requirements, and Test Procedures for Combined Coatings of Anodic Oxide and Transparent Organic Coatings on Architectural Aluminum, current standard .

C. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels, current standard.

D. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for

E. Superior Performing Organic Coatings on Aluminum Extrusions and Panels, current standard. E. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes, current standard.

F. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength, current standard.

G. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process, current standard.

H. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate, current standard.

I. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric), current standard.

J. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes, current standard.

K. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric), current standard.

L. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position, current standard.

M. ASTM D1929 - Standard Test Method for Determining Ignition Temperature of Plastics, current standard.

N. latest edition D2843 - Standard Test Method for Density of Smoke from the Burning or Decomposition of Plastics , current standard.

O. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials, current standard.

P. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs, current standard.

Q. NFPA 268 - Standard Test Method for Determining Ignitibility of Exterior Wall Assemblies Using a Radiant Heat Energy Source, current standard.

R. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components, current standard.

S. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films, current standard.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Meeting: Schedule and conduct a pre-installation meeting one week before starting work of this section. Attendees shall include, but are not limited to:
1. Contractor.
2. Manufacturer's representative.
3. Architect.
4. Owner's representative.
5. Other subcontractors of adjacent work.

1.4 SUBMITTALS

A. See Division 01, Administrative Requirements for submittal procedures.

B. Shop Drawings: Prior to commencement of fabrication, submit detailed shop drawings, showing all profiles, sections of all components, finishes, fastening details, and manufacturer's technical and descriptive data. Include field dimensions of openings and elevations on shop drawings.

C. Product Data: Submit manufacturer's product data, including description of materials, components, finishes, fabrication details, anchors and accessories.

D. Samples: Submit two (2) of each item below:
1. If requested, provide up to six different powder coat samples for submittal review.
2. 3 inch by 6 inch minimum size sample of finish color.
3. Pattern Sample: Submit 12 inch by 12 inch flat panel, with finish

E. Test Reports: If required, submit test reports from an independent testing agency showing compliance with specified design and performance requirements. G. Manufacturer's Installation Instructions.

F. Manufacturers storage and handling instructions.

G. Sustainable Design Submittals:
1. In accordance with Division 01 sustainable design requirements.

H. Maintenance Data: Manufacturer's instructions for care and cleaning.

I. Designer's Qualification Statement.

J. Manufacturer's Qualification Statement.

K. Installer's Qualification Statement.

L. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

A. Verification and Coordination:
1. Verify actual locations of walls and other construction contiguous with the work of this Section using field measurements before fabrication. Indicate measurements on Shop Drawings.
2. Embedded Anchor Plates and Structural Connections: Coordinate support sizes and locations.

B. Engineering:
1. Structural attachment or connections to be engineered by the Engineer of Record for the Project.

C. Installer Qualifications: Company specializing in installation of fixed sun shade systems with a minimum of five years of documented experience and certified or approved by manufacturer.

D. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than ten years of documented experience.

E. Fabricator Qualifications: Company specializing in fabrication of products of the type specified in this Section with a minimum of 8 years of documented experience and sufficient production capacity to produce the required units within the Project schedule.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original protective coverings and packaging with corresponding labels and identifying information.

B. Protect materials against damage during transit, delivery, storage, and installation at site. Protect against bending, warping, twisting or surface damage. Store in accordance with manufacturers written instructions and in a dry location.

C. Inspect materials upon delivery for damage. Repair damage to be indistinguishable from undamaged areas; if damage cannot be repaired to be indistinguishable from undamaged parts and finishes, replace damaged items.

D. Deliver materials to project site ready for erection.

1.7 MOCKUPS

A. Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
   1. Location: As approved 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.

1.8 WARRANTY

A. See Section 017700 "Closeout Submittals", for additional warranty requirements.

B. Correct defective work within a one year period after Date of Substantial Completion.

C. Warranty: Manufacturer's standard one year warranty against defects in materials, fabrication, finishes, and installation commencing on Date of Substantial Completion.

D. Warranty on FEVE and PVDF Finishes: Provide manufacturer's standard 10 year warranty on finish.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Sun Shades: Provide products from manufacturer below:
   1. BOK Modern, Inc.; Bracketed Canopy. www.bokmodern.com
      a. Or equal.
   2. Substitutions: See Section 016000 "Product Requirements."
   3. Perforation Pattern: None.
   4. Finish: Fluoropolymer Coating.
   5. Color: Custom color match orange.
      a. Basis of Design: 399Q0117 Fluropon Continuum Ablaze (Sherwin Williams)

2.2 MATERIALS

A. Metal Surfaces: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations or blemishes; unless allowed for specific metal types and finishes.

B. Perforated Aluminum Sheet: AA5052-H32, 0.1875-inch (4.76 mm)

C. Fasteners: ASTM F593 stainless steel
1. Mounting Brackets. Stainless Steel.

2.3 FABRICATION

A. Fabricate assemblies to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish and anchorage, but not less than required to support structural loads.

B. Fabricate in accordance with approved shop drawings and manufacturers written instructions. Form work true to line and level with accurate angles and surfaces.

C. Assemble in the shop to greatest extent possible to minimize field splicing and assembly.

D. Cut, drill and laser cut metals cleanly and accurately. Remove burrs and ease edges; unless allowed for specific metal types and finishes. Remove sharp or rough areas on exposed surfaces.

E. Cut, reinforce, drill and tap as indicated to receive finish hardware, screws and similar items.

F. Use grommets, bushings and washers or methods as recommended by the manufacturer for separation of dissimilar metals.

2.4 FINISHES

A. Comply with NAAMM's MFM for recommendations for applying and designating finishes.
1. Appearance of Finished Work:
a. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved samples.
b. Noticeable variations in same piece are not acceptable except for steel and anodized aluminum.
c. 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. Finishes for Aluminum; Fluoropolymer Coating to meet AAMA 2605:
1. Pretreat according to manufacturer's instructions and AAMA 2605 to withstand a minimum of 3000 hours (ASTM B117) or 2000 hours (ASTM G85) salt spray testing.

2. Apply standard available colors, high volume RAL, or high volume custom color matches in single coat powder finish containing no less than 100% FEVE (fluorinated ethylene vinyl ether) at a minimum of 2.0 mils and process according to manufacturer's recommendations.

C. Stainless Steel:
1. Powder coat to match sunshade color or finish to match sunshade finish.

2.5 ACCESSORIES

A. Welding Fittings: Factory- or shop-welded from matching pipe or tube; joints and seams ground smooth.

B. Bracket:
1. Stainless steel bracket with flat mounting plate and recessed #12 screws provided by shade manufacturer.
2. Finish: Powder coat.
3. Color: To match shade.
4. Manufacturer: Manufactuer of shade.

C. Anchors and Fasteners:
1. Select fasteners of type, grade and class required to product connections for anchoring metal panels to other types of construction indicated and capable of withstanding design loads.
2. Provide anchors and other materials as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
3. Do not use metals that are corrosive or non-compatible with materials joined. Avoid fastening dissimilar materials and separate with isolating hardware where necessary.
   a. For anchorage to concrete, provide inserts to be cast into concrete for bolt anchors.
   b. For anchorage to masonry, provide brackets to be embedded in masonry for bolt anchors.
   c. For anchorage to stud walls, provide backing plates for bolt anchors.
   d. Posts: Provide adjustable flanged brackets.
4. Exposed Fasteners: Manufacturer provided stainless steel finished/rounded-end ½" bolt assembly.

D. Bituminous Coating: Cold-applied asphalt mastic, noncorrosive compound free of asbestos, sulfur, and other deleterious impurities; 0.015 inch (0.4 mm) dry film thickness per coat complying with ASTM D1187. G. Sealant: Silicone; black.

E. Finish Touch-Up Materials: As recommended by manufacturer for field application.

F. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

G. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and site area for conditions that might prevent satisfactory installation.

B. Verify that dimensions of supporting structure are within plus/minus 1/8 inch (3.175 mm) of dimensions indicated on shop drawings.

C. Verify that all adjacent painting, roofing, masonry work, and other work that might damage sun shade finish has been completed prior to installation of sun shades.

D. Do not install until after all adjacent painting, roofing and masonry have been completed.

E. Do not proceed with installation until all conditions are satisfactory.

F. Notify Architect immediately of conditions that would prevent satisfactory installation.

G. Do not proceed with work until detrimental conditions have been corrected.

H. Furnish components to be installed in other work to installer of that other work, including but not limited to blocking, sleeves, inserts, anchor bolts, embedded plates, and supports for attachment of anchors.

3.2 INSTALLATION

A. Comply with Drawings and manufacturer's written instructions.

B. Set units level, plumb, with uniform joints, and aligned with building elements.

C. Fit exposed connections together to form tight, hairline joints per manufacturers recommendation for seismic movement or thermal expansion and contraction

D. Do not cut or trim aluminum members without approval of manufacturer; do not install damaged members

E. Adjust before anchoring to ensure alignment at abutting joints.

F. Use manufacturer's hardware for connections.

G. Attach securely in place using anchorage devices and fasteners as approved by Engineer of Record.

H. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

I. 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. J. Universal Bracket: Install per manufacturers printed instructions.

J. Weld connections that cannot be shop welded due to size limitations.
1. Weld in accordance with AWS D1.1/D1.1M.
2. Match shop welding and bolting.
3. Clean welds, bolted connections, and abraded areas.
4. Touch up shop primer and factory-applied finishes.
5. Repair galvanizing with galvanizing repair paint per ASTM A780/A780M.

K. Isolate dissimilar materials with bituminous coating, bushings, grommets, or washers to prevent electrolytic corrosion.

L. Touch-up damaged finish coating using material provided by manufacturer to match original coating.

3.3 FIELD QUALITY CONTROL

A. Field Services: Provide the services of the manufacturer for field observation of installation.

3.4 TOLERANCES

A. Maximum Variation from Level: Plus/Minus 1/8 inch (3.175 mm).

3.5 CLEANING

A. Remove protective film from exposed metal surfaces.

B. Metal: Clean exposed metal finishes with potable water and mild detergent, in accordance with manufacturer recommendations; do not use abrasive materials or chemicals, detergents, or other substances that may damage the material or finish.

3.6 ADJUSTING AND PROTECTION

A. Touch-up and repair damage to exposed finishes to be indistinguishable from undamaged areas.
1. If damage to finishes and components cannot be repaired to be indistinguishable from undamaged finishes and components, replace damaged items.
2. Obtain approved coating for repainting surfaces from manufacturer.

B. Return and replace items that cannot be repaired or refinished in field.

C. Protect installed components and finishes from damage after installation.

END OF SECTION

SECTION 109000 - MISCELLANEOUS SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Dumpster mover.
2. Secure drop box.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain each type or required product from a single manufacturer.
1. Accessories: Provide accessory items only as produced or recommended by manufacturer of primary products.

PART 2 - PRODUCTS

2.1 DUMPSTER MOVER

A. Dumpster Mover:
1. Basis-of-Design Product: DJ Products, Inc.; WasteCaddy Lite.

2.2 SECURE DROP BOX

A. Secure Drop Box: Locking collection box with adjustable chute for walls between 3.25 to 7.75 inches thick; Drop slot opening 10 inches wide by 1/2 inch thick for large envelopes and legal size papers.
1. Product: Protex Safe Co.; MDL-170.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Inspect substrates and conditions under which the work of this section will be performed, and verify that installation properly may commence. Do not proceed with the work until unsatisfactory conditions have been resolved fully.

3.2 INSTALLATION

A. General: Comply with manufacturer's instructions, except where more stringent requirements are shown or specified, and except where project conditions require extra precautions or provisions to ensure satisfactory performance of the work.

3.3 ADJUSTING

A. Final Adjustments: Upon achieving substantial completion of the work, adjust all operable components to ensure that they are properly installed and functioning smoothly. Replace any component which cannot be adjusted for proper operation.

3.4 CLEANING

A. Upon completion, clean all surfaces which have become soiled or coated as a result of work of this section, using proper methods which will not scratch or otherwise damage finished surfaces.

3.5 PROTECTION

A. General: Institute protective procedures and install protective materials as required to ensure that work of this section will be without damage or deterioration at substantial completion.

END OF SECTION

SECTION 113013 - RESIDENTIAL APPLIANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: ADA and CBC Chapter 11B code compliant:
1. Cooking appliances.
2. Kitchen exhaust ventilation.
3. Refrigeration appliances.
4. Cleaning appliances.
5. Laundry appliances.
6. Trash room appliances.

B. Refer to "Equipment, Appliance & Accessory Schedule" in the drawings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:
1. Product Data: For indicated products, indicating compliance with requirements for ENERGY STAR product labeling.

C. Product Schedule: For appliances. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of appliance.

B. Field Quality-Control Reports: From field quality-control tests and inspections.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each residential appliance to include in operation and maintenance manuals.

B. Warranty: For each residential appliance, manufacturer's standard warranty.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Appliances: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 RANGES

A. Electric Range: Complying with AHAM ER-1.
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings, or equal.
2. Anti-Tip Device: Manufacturer's standard.

2.3 MICROWAVE OVENS

A. Microwave Oven:
1. Basis-of-Design Product: Subject to compliance with requirements, Owner provide product indicated on Drawings, or equal.
2. Microwave Power Rating: Manufacturer's standard.

2.4 KITCHEN EXHAUST VENTILATION

A. Overhead Exhaust Hood:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings, or equal.

2.5 REFRIGERATOR/FREEZERS

A. Refrigerator/Freezer: Complying with AHAM HRF-1.
1. Basis-of-Design Product: Subject to compliance with requirements, Owner provide product indicated on Drawings, or equal.

2.6 DISHWASHERS

A. Dishwasher : Complying with AHAM DW-1.
1. Basis-of-Design Product: Subject to compliance with requirements, Owner provide product indicated on Drawings, or equal.

2.7 COMMERCIAL CLOTHES WASHERS / DRYERS AND ACCESSORIES

A. Housekeeping Washer: Owner provided.

B. Housekeeping Dryer: Owner provided.

C. Stack Washer/Dryer: Subject to compliance with requirements, Owner provide product indicated on Drawings, or equal.
   1. Anti-Tip Device: Manufacturer's standard.

D. Stack Dryer/Dryer: Subject to compliance with requirements, Owner provide product indicated on Drawings, or equal.
   1. Anti-Tip Device: Manufacturer's standard.

E. ADA Washer: Subject to compliance with requirements, Owner provide product indicated on Drawings, or equal.
   1. Anti-Tip Device: Manufacturer's standard.

F. Laundry Pay Station: Subject to compliance with requirements, Owner provide product indicated on Drawings, or equal.

G. Laundry Alert System: Subject to compliance with requirements, Owner provide product indicated on Drawings, or equal.

2.8 TRASH ROOM APPLIANCES

A. Trash Compactor: Subject to compliance with requirements, Owner provide product indicated on Drawings, or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. 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.

B. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

C. Anti-Tip Devices: Install at each piece of equipment indicated according to manufacturer's written instructions.

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
   1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance-performance parameters.
   2. 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. Prepare test and inspection reports.

3.3 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain residential appliances.

END OF SECTION

SECTION 122200 - DRAPERIES AND CURTAINS

PART 1 - SUMMARY

1.1 SUMMARY

A. Section Includes:
1. Drapes.
2. Drapery tracks.
a. Motorized at mobility units and director's apartment.

1.2 Related Sections:

A. Section 061000 "Rough Carpentry" for wood blocking.

B. Electrical drawings for motorized track electrical work.

1.3 SYSTEM REQUIREMENTS

A. Fire Resistance Requirements:
1. Noncombustible Materials: Flame spread index of 25 maximum and smoke developed index of 450 maximum; ASTM E84.
2. Treated Materials: Flame resistant treated to generate smoke density less than that given off by untreated wood or paper burning under comparable conditions when tested in vertical flame test; NFPA 701.

1.4 SUBMITTALS

A. General: Submit in accordance with Section 013323 "Shop Drawings, Product Data and Samples."

B. Product Data:
1. Submit product data for draperies and curtains.
2. Include data to indicate fabric material content and construction, flame spread and smoke developed indices, and materials used for stain and flame resistance treatments, if any.
3. Include dimensioned track profiles and shapes, track load data, and finishes available.

a. Motorized Tracks: Indicate motor weights, motor-mounting requirements, and electrical requirements.

C. Shop Drawings:
1. Submit shop drawings for draperies and curtains.

2. Indicate typical layout including dimensions and end of track locations, width of window openings, location of blocking for anchors, appurtenances and interferences, and support bracket details.
3. Submit detail drawings of special accessory components not included in manufacturer's product data.
4. Submit overall plans showing locations of all draperies and motorized draperies.

D. Samples:
1. Submit 12 by 12 inch fabric samples illustrating pattern, color, and texture.
2. Submit 12 inch long samples of track illustrating variations in color and finish.

E. Informational Submittals: Submit the following
1. Test Reports: Submit written results of flame testing specified in System Requirements article.
2. Certifications: Submit certifications specified in Quality Assurance article.
3. Qualification Data: Submit fabricator's qualification data.
4. Manufacturer's instructions. Submit manufacturer's printed installation instructions.
5. Coordination drawings:
   a. Structural members to which motors are attached.
   b. Size and location of motor access panel.

F. Closeout Submittals:
1. Submit under provisions of Section 017700 "Closeout Submittals."
2. Operation and Maintenance Data. Submit manufacturer's printed, recommended operation and maintenance data. Include precautions in use of cleaning materials which may be detrimental to surface if improperly applied.
3. Warranty: Submit specified product warranty in accordance with Section 017800 "Closeout Submittals."

1.5 MOCKUPS

A. Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
1. Location: As approved 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.

1.6 QUALITY ASSURANCE

A. Single Source Responsibility:
1. Furnish track components from one manufacturer for entire Project, unless otherwise acceptable to University's Representative.
2. Provide each track assembly as complete unit, including carriers and accessory items necessary for proper operation.

B. Fabricator Qualifications: Company specializing in fabricating work specified in this Section with minimum 5 years documented experience.

C. Regulatory Requirements: Ensure fabric and plastic components comply with applicable portions of local, state, and federal codes, laws, and ordinances for flame spread and smoke developed indices.

D. Certifications: Submit certificate of compliance from authority having jurisdiction indicating approval of fabric flame resistance.

1.7 FIELD SAMPLES

A. Sample Installation:
1. Install one full size operable drapery unit in location as directed by Architect.
2. Show hanging and operation techniques.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of Section 016000.

1.9 PROJECT CONDITIONS

A. Do not install draperies until dirt and dust generating activities have ceased.

1.10 MAINTENANCE

A. Maintenance Materials:
1. Furnish under provisions of Section 017700.
2. Furnish extra draperies for each type and color equal to 10 percent of total material furnished.
3. Identify drapery indicating manufacturer, dye lot number, production run date, finish, color, fiber content and quantity.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

A. Basis of Design Track Product and Manufacturer: Architrac 94001 Series, Kirsch, Sturgis, MI.

B. Other Acceptable Track Manufacturers:
1. Automatic Devices Company, Allentown, PA.
2. Baker Drapery Corporation, Peoria, IL.
3. Graber Window Treatments, Montgomery, PA.

C. Acceptable Fabric Manufacturers:

1. Basis of Design Fabric: Refer to Finish Schedule on Drawing Sheet A10.30, Designation **WT**.
2. Maharam/Vertical Surfaces, Hauppauge, NY.
3. KnollTextiles, New York, NY.

2.2 HAND DRAW TRACK COMPONENTS

A. Provide Basis of Design System or approved equal:
   1. Architrac 94001 Series (non-motorized), Kirsch, Sturgis, MI.

B. Track: Channel shaped; 1 inch wide by 3/4 inch high; extruded 0.050 inch aluminum.

C. End Caps: Manufacturer's compatible.

D. Master Carriers: Manufacturer's compatible roller bearing carriers.

E. Drapery Carriers: To suit fabric and fold design.

F. Baton: 3/8 inch diameter, white fiberglass; 3 [4] [5] [6] foot length.

G. Mounting Brackets: Single track, wall or ceiling mount type as dictated by Project conditions.

2.3 MOTORIZED TRACK

A. Provide Basis of Design System or approved equal:
   1. Architrac 94001 Series (motorized), Kirsch, Sturgis, MI.

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. Construction: Extruded aluminum, slotted for mounting at interval of not more than 24 inches (610 mm) o.c.

D. Lengths and Configurations: As indicated on Drawings.

E. Support Capability: Weight of drape indicated mounted on track length indicated.

F. Finish: As indicated in drawings finish schedule.

G. Mounting Brackets: Suitable for fastening track to surface indicated and designed to support weight of track assembly and drape plus force applied to operate track.

H. Installation Fasteners: Sized to support track assembly and drape, and fabricated from metal compatible with track, brackets, and supporting construction. Provide two fasteners to fasten each bracket to supporting construction.

I. Motor Operation: Low-voltage motor with built-in low-voltage interface for direct access to control systems, with thermal-overload switch; sized for weight of drape and track length indicated; and equipped with stops to prevent overdrawing.

J. Control: Wall switch.

K. Draw: Stack as indicated on Drawings.

L. Electrical Requirements: As indicated on Drawings.

M. Carriers: As selected from manufacturer's standard range.

N. End Stops: Manufacturer's standard with track end cap.

O. Pulleys: Heavy duty.

2.4 DRAPERY MATERIALS AND COMPONENTS

A. Face Fabric: As indicated in the Drawings.

B. Standard Liner Fabric: Manufacturer's standard blackout fabric.

C. Buckram Heading Stiffener: Non-woven, heavyweight, spunbonded polyester; 4 [2] inch width.

D. S-fold Snap Tape: Kirsch Number 92145 stiffened nylon tape with chrome plated brass snaps on 4-1/4 inch centers.

E. Hem Weights: Fabric covered 0.5 oz lead weights.

F. Pinch Pleat Hooks: Stainless steel pin type hooks; size to provide proper hanging distance below track.

G. Thread: Mercerized cotton, cotton/polyester or polyester fiber compatible with fabric fiber. Match fabric color.

2.5 DRAPERY FABRICATION

A. Prior to fabrication, field measure actual existing conditions to ensure proper fit.

B. Fabricate drapes in conventional pinch pleat [S-fold] [Z-fold] [pleated Z-fold] method.

C. Lay out fabric to match patterns at vertical seams so that finished panels are identical and interchangeable.

D. Join vertical seams and serge, trim, and overlock stitch with even seams, free of puckering. Locate seams in inconspicuous areas between fabric folds.

E. Use full width fabric with no more than one single half width section per panel.

F. Hem sides to 1-1/2 inch wide, double turned, triple thickness [single turned, double thickness] and blind stitch.

G. Hem tops to 4 [2] inch wide, double turned, triple thickness [single turned, double thickness] with buckram heading.

H. [titch snap tape to heading in accordance with manufacturer's instructions.

I. Hem bottoms to 4 inch wide, double turned, triple thickness. Blind stitch with hem weights at seams and sides.

J. Fabricate drapes to provide minimum 100 percent fullness.

K. Provide hobbling thread in the bottom hem of malimo weave and polyester fabric drapes. Leave end pleats free.

2.6 FINISHES

A. Metal Finish: Color and finish as selected by Architect from samples submitted.

2.7 SOURCE QUALITY CONTROL

A. General: Comply with requirements of Section 014000.

B. Fabrication Tolerances:
1. Size drapery length to within 1/4 inch plus or minus.
2. Size drapery width to provide 12 inch overlap beyond sides of openings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions and proceed with Work in accordance with Section 017300.

B. Verify that concealed blocking and structural supports are in correct position.

3.2 INSTALLATION

A. Install components in accordance with Section 017300 and approved shop drawings.

B. Install track plumb, level, square, and free from warp or twist while maintaining dimensional tolerances and alignment with surrounding construction.

C. Extend track 12 inches beyond sides of window trim.

D. Mount track support brackets on solid backing. Where mounting location does not align with solid backing, provide expanding anchors for each screw hole location.

E. Anchor tension pulley to wall directly below and in line with track end pulley. Locate bottom of tension pulley assembly 6 inches above floor.

F. Hang draperies with tops parallel with and equidistant from ceiling.

3.3 ADJUSTING

A. Adjust parts for smooth, uniform operation.

3.4 CLEANING

A. Clean metal and plastic components as recommended by manufacturer. Do not use materials or methods which may damage finish or surrounding construction.

3.5 PROTECTION

A. Protect finished work in accordance with Section 017300.

B. If dust generating activities are ongoing, remove drapes and store in location to prevent soiling. Rehang drapes prior to Substantial Completion of Project.

END OF SECTION

SECTION 122413 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Motor operated roller window shades. **RS-1 RS-2**
      a. ADA and CBC Chapter 11B code compliant.
      b. Includes all components for a complete system connected to campus BMS.
   2. Motor operated roller window shades – decorative. **RS-3**

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product including:
   1. Preparation instructions and recommendations.
   2. Installation and maintenance instructions.
   3. Styles, material descriptions, dimensions of individual components, profiles, features, finishes, and operating instructions.
   4. Storage and handling requirements and recommendations.
   5. Mounting details and installation methods.
   6. Typical wiring diagrams including integration of motor controllers with building management system, audiovisual, and lighting control systems as applicable.

B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.

C. Samples: For each exposed product and for each color and texture specified.

D. Window Treatment Schedule: For all roller shades. Use same room designations as indicated on the Drawings, field verified window dimensions, quantities, type of shade, controls, fabric, and color, and include opening sizes and key to typical mounting details.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of shadeband material.

B. Product Test Reports: For each type of shadeband material, for tests performed by a qualified testing agency.

C. Maintenance Data: Methods for maintaining roller shades, precautions regarding cleaning materials and methods, instructions for operating hardware, and controls.

D. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

E. Standard manufacturer's defect warranty: Standard manufacturer's warranty documents.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roller shades to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

1.7 MOCKUPS

A. Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
   1. Location: As approved 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.

1.8 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. Hardware and Shade Fabric: Manufacturer standard twenty-five-year limited warranty.

B. Motors and Controls: Manufacturer standard five-year limited warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Draper.
2. Hunter Douglas Contract.
3. MechoShade Systems, Inc.
4. Or equal.

B. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.2 MOTOR OPERATED ROLLER WINDOW SHADES **RS-1 RS-2**

A. Motor Operating System: Manufacturer's complete system and accessories suitable for conditions indicated, recommended by manufacturer for use with shade indicated, and as required for reliable operation without malfunction.
1. Provide Basis of Design or Approved Equal:
   a. Draper Motorized FlexShade I/O DC.
2. Power: DC over Ethernet
3. Controls:
   a. Physical RS 485 switch for group operation of ganged shades by wall.
   b. Connect to campus BMS and program operation based on timeclock over day and year.
      1) Owner-standard BMS: WebCTRL.
4. Noise: 38 dBA maximum, measured 3' from shade.
5. Motor: DC, 4nm, instantly reversible, lifetime lubricated smart motor. Tubular motor concealed inside each shade roller tube. Equipped with internal thermal overload protector, and electric brake. Thermal protection: 4 minutes.
6. Wiring.
   a. Power/Data Cable: A single Cat5 or Cat6 cable shall distribute both power and data between the motor and the Power Distribution Panel. Systems that require more than one cable for power and data shall not be equivalent/acceptable.
   b. Maximum Cable Distance: Maximum distance between motor and power source shall be 550 feet (106.68 meters) for 24 AWG Cat5/Cat6 Cable and 700 feet (167.64 meters) for 22 AWG Cat5/Cat6. Systems with shorter cable runs shall not be equivalent/acceptable.
   c. No proprietary wire should be accepted.
7. Networking.
   a. Power panels shall be capable of being directly networked together to create a shade control network or connected to an existing IP network via network switches to create a shade control network.
   b. There shall be no limitation on the number of power panels that can be networked together in a single network.
8. Power.
   a. System shall be capable of powering up to 24 motors from a 20 Amp circuit breaker.

9. Performance.
    a. Input speed control – Allows for motor rotation speed to be set to different speeds based on automated system inputs vs inputs from user interfaces.
    b. Soft Start/Soft Stop. Ability to adjust the rotational speed at which the motor starts/stops vs the rotational speed of the motor while moving.
10. Power Distribution Panels shall have the ability to power 12 motors from a single Power Panel. A maximum of 4000 feet (1219.2 meters) is allowed between power panels. Power ports shall have the ability to sense output power requirements and adjust the voltage accordingly to prevent damage to hardware. Panels to automatically detect short circuits on motor lines and shut off power to that port. Directly compatible with IP interfaces to allow for control over individual or groups of shades.
    a. 6-Motor DC Power Distribution Panel available as rack mount or wall mount.
    b. 12-Motor DC Power Distribution Panel available as rack mount or wall mount.

B. Rollers: Corrosion-resistant 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 Mounting Configuration: Single roller.
    2. Roller Drive-End Location: As indicated on Drawings.
    3. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
    4. 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.
    1. Brackets: 1/8-inch-thick stamped steel, powder coat, idler height adjuster, field adjustable to wall or ceiling mount.

D. Coupling system: Couplings to join motorized shade rollers to allow operation by single motor. FlexShade Coupling System as manufactured by Draper, Inc. Provide endcaps to receive couplers and support multiple shades.
    1. Standard straight coupler.
    2. Angled coupler.
    3. Naked roller at spandrel panels in storefront.

E. Fascia:
    1. Aluminum: Manufacturer’s standard two-piece concealing valance.
    2. Provide Surface Headbox back cover and valence where indicated.
        a. Color: Dark bronze anodized – to match curtainwall and storefront profiles.

F. Endcap covers to match fascia/headbox finish.

2.3 MOTOR OPERATED ROLLER WINDOW SHADES AT WELLNESS ROOM AND DIRECTOR'S APARTMENT **RS-3**

A. Motor Operating System: Manufacturer's complete system and accessories suitable for conditions indicated, recommended by manufacturer for use with shade indicated, and as required for reliable operation without malfunction.
   1. Provide Basis of Design or Approved Equal:
      a. Draper Motorized FlexStyle Cassette Motorized RTS AC.
   2. Power: 110VAC.
   3. Controls:
      1) Wireless RF with wall-mounted keypads (battery).
         a) Basis of Design: Decoflex WireFree 3-Button (one per shade).
   4. Noise: 38 dBA maximum, measured 3' from shade.
   5. Motor: DC, 4nm, instantly reversible, lifetime lubricated smart motor. Tubular motor concealed inside each shade roller tube. Equipped with internal thermal overload protector, and electric brake. Thermal protection: 4 minutes.
      a. Basis of Design: Sonesse RTS Ultra

B. Rollers: Corrosion-resistant 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 Mounting Configuration: Single roller.
   2. Roller Drive-End Location: As indicated on Drawings.
   3. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
   4. 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.
   1. Brackets: Sprink-loaded ceiling mounting brackets of plastic and steel. Minimum of two per cassette.

D. Cassette:
   1. Aluminum: Manufacturer's standard concealing valance wrapped with matching shade band.
      a. Finish: Selected from manufacturer's standard colors to coordinate with shade band material.
   2. Shape: Square Cassette.
   3. Dimensions: 4 inches tall by 4 inches deep including bracket.
   4. Mounting: At top recessed in window opening.
      a. Ceiling mounting brackets.
   5. Endcaps: Integral to cassette.

2.4 SHADEBAND MATERIALS **RS-1 RS-2 RS-3**

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. Type: As indicated in finish schedule.
   3. Openness Factor: As indicated in finish schedule.
   4. Color: As indicated in finish schedule.

C. Shadeband Bottom (Hem) Bar: Extruded aluminum.
   1. Type: Enclosed in sealed pocket of shadeband material.

2.5 ROLLER SHADE FABRICATION

A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1

B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:
   1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch. Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch, plus or minus 1/8 inch.
   2. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:
   1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.
   2. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordinate requirements for blocking, construction of shade pockets, and structural supports to ensure adequate means for installation of window shades.

B. Coordinate installation of recessed shade pockets with construction of suspended acoustical panel ceilings specified in Section 09 51 13.

C. Coordinate requirements for power supply conduit, and wiring required for window shade motors and controls.

3.3 MOTOR OPERATED ROLLER SHADE INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.

C. Shade pockets:
   1. Install shade pockets prior to installation of suspended ceiling system. Attach to supporting structure with screws through top of pocket at 24 inches (610 mm) minimum centers.
   2. Install shade pockets in conjunction with installation of suspended ceiling system. Attach to supporting structure with screws through top of pocket at 24 inches (610 mm) minimum centers.
      a. Install corner pieces securely and in alignment with pockets.
      b. Install pocket ends securely and in alignment with pockets.
   3. After interior construction is essentially complete, install shade and operating mechanism in pocket.

D. Install the following items to conceal roller and operating mechanism. Do not use exposed fasteners.
   1. Fascias.
   2. Closure panels.
   3. Endcaps.

E. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 TESTING AND DEMONSTRATION

A. Test motorized window shades to verify that controls, limit switches, interface to other building systems, and other operating components are functional. Correct deficiencies.

B. Test window shades to verify that operating mechanism, fabric retainer, and other operating components are functional. Correct deficiencies.

C. Demonstrate operation of shades to Owner's designated representatives.

3.5 CLEANING AND PROTECTION

A. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.

B. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION

SECTION 123661.19 - QUARTZ AGGLOMERATE COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Quartz agglomerate countertops and back and side splashes (SS-1 and SS-2).

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for steel supports for countertops.
2. Section 064116 "Plastic-Laminate-Clad Casework".
3. Section 093000 "Tiling".
4. Division 22 "Plumbing" for coordination of sinks and plumbing fixtures.
5. Room Finish Schedule on the Drawings for specific products, colors, and finishes.

1.2 SUBMITTALS

A. Product Data: For countertop materials.

B. 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.

C. Samples for Initial Selection: For each type of material exposed to view.

D. Samples for Verification: For the following products:

1. Countertop material, 6 inches square.

E. Qualification Data: For fabricator.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For countertops include maintenance manuals. Include product data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of countertops.

1.5 FIELD CONDITIONS

A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.6 COORDINATION

A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

1.7 GUARANTEE

A. Furnish to Owner a written guarantee for systems and system components specified in this Section against all defects in materials and workmanship, agreeing to repair or replace those systems and system components that do not comply with requirements or that fail to perform as required, and to maintain performance indicated or required for 10 years from date of acceptance. Refer to Section 017800 Closeout Submittals for submittal form.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Caesarstone.

B. Or equal.

2.2 QUARTZ AGGLOMERATE COUNTERTOPS, SS-1 AND SS-2

A. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of polymers, resins, and pigment and complying with ISFA 3-01.

1. Sizes: As indicated in Drawings.
2. Thickness: 3/4 in.
3. Backsplash Height: As indicated in Drawings.
4. Slab Width: As indicated in Drawings.
5. Edge Nosing Width: As indicated in Drawings.
6. Edge Style: Slightly eased edge.
7. Color and Finish: Refer to Interior Finish Legend.

2.3 SUBSTRATES

A. Provide solid surfacing custom-fabricated countertops as indicated.

1. Solid-surfacing countertops with Woodworks Institute-recommended backing and adhesive; homogeneous solid-surfacing material per ISSFA-2; Integral backsplashes and aprons.

B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Thickness: 3/4 in.

C. Finish: Field-painted.

2.4 COUNTERTOP FABRICATION

A. Fabricate countertops according to manufacturer's written instructions and the WI's "Architectural Woodwork Standards."

B. Grade: Premium. Configuration:

1. Front and Exposed Ends: Straight, slightly eased edge at top.

C. Fabricate tops with shop-applied edges unless otherwise indicated. Comply with manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

1. Fabricate with loose backsplashes for field assembly.

D. Cutouts and Holes:

1. Undercounter Plumbing Fixtures: Make cutouts for fixtures using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.

a. Furnish and install vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch into fixture opening.

b. Furnish and install vertical edges, rounded to 3/8-inch radius at juncture of cutout edges with top surface of countertop, slightly eased at bottom, and projecting 3/16 inch into fixture opening.

c. Furnish and install 3/4-inch full bullnose edges projecting 3/8 inch into fixture opening.

2. Counter-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.

3. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

2.5 INSTALLATION MATERIALS

A. Adhesive: Product recommended by countertop manufacturer.

1. Adhesives shall have a VOC content of 70 g/L or less.

2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to receive solid surface 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 PREPARATION

A. Before installation, condition fabrications to humidity conditions in installation areas for not less than 72 hours prior to beginning of installation.

B. Before installing, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming of concealed surfaces.

3.3 INSTALLATION OF COUNTERTOPS

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 subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.

C. Secure countertops to subtops with adhesive according to solid surface manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with solid surface manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

D. 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. 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.

E. 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.

F. 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.

G. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

1. Seal edges of cutouts in subtops by saturating with varnish.

H. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION

SECTION 124813 - ENTRANCE FLOOR MATS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Resilient entrance mats.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show the following:
1. Items penetrating floor mats, including door control devices.
2. Divisions between mat sections.

C. Samples: For each exposed product and for each color and texture specified.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For floor mats and frames to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 ENTRANCE FLOOR MATS AND FRAMES, GENERAL

A. Accessibility Standard: Comply with applicable provisions in the DOJ's "2010 ADA Standards for Accessible Design" and California Building Code, Chapter 11.

2.2 RESILIENT ENTRANCE MATS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings.
1. Cocoa Mats: Constructed from cocoa fiber yarn permanently bonded to resilient backing for dimensional stability and resistance to shedding; 1-3/8-inch overall thickness.
2. Exterior: Matsinc, or equal.
3. Interior Proform, or equal.

2.3 FABRICATION

A. Floor Mats: Shop fabricate units to greatest extent possible in sizes indicated. Unless otherwise indicated, provide single unit for each mat installation; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units to comply with manufacturer's written instructions; coordinate with entrance locations and traffic patterns.

END OF SECTION

SECTION 142100 - ELECTRIC TRACTION ELEVATOR

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies gearless electric traction elevators.

B. Related Sections:
1. Section 015000 "Temporary Facilities and Controls" for protection of floor openings and personnel barriers; temporary power and lighting.
2. Section 033000 "Cast-In-Place Concrete" for elevator pit, and elevator machine foundation.
3. Section 055000 - Metal Fabrications: Divider beams, and supports for entrances, rails and hoisting beam at top of elevator shaft, pit ladder.
4. Section 071700 – Bentonite Composite Sheet Waterproofing: Waterproofing of elevator pit.
5. Division 21 Section: Fire and smoke detectors at required locations and interconnecting devices; fire alarm signal lines to contacts in the machine room.
6. Division 23 Sections: Ventilation and temperature control of elevator equipment areas.
7. Division 26 Sections:
   a. Main disconnects for each elevator.
   b. Electrical power for elevator installation and testing.
   c. Disconnecting device to elevator equipment prior to activation of sprinkler system.
   d. The installation of dedicated GFCI receptacles in the pit and overhead (with Machine room-less).
   e. Lighting in controller area, machine area and pit.
   f. Wiring for telephone service to controller.
8. Division 26 Section:
   a. ADAAG-required emergency communications equipment.
   b. Coordinate interconnection with Owner's access control software, card readers, security camera and alarm systems.

C. Applicable Codes: Comply with applicable building codes and elevator codes at the project site, including but not limited to the following:
1. Accessibility:
   a. ANSI A117.1, Buildings and Facilities, Providing Accessibility and Usability for Physically Handicapped People.
   b. CBC Chapter 11B.
2. ADAAG, Americans with Disabilities Act Accessibility Guidelines.
3. ANSI/NFPA 70, National Electrical Code.
4. ANSI/NFPA 80, Fire Doors and Windows.
5. ASME/ANSI A17.1, Safety Code for Elevators and Escalators.
6. ANSI/UL 10B, Fire Tests of Door Assemblies.
7. California Building Code (CBC).

1.2 SYSTEM DESCRIPTION

A. Equipment Description: Otis Gen3 Edge gearless traction elevator as specified pr approved equal.

B. Equipment Control: Manufacturer's standard control system.
   1. Provide integration with card reader controls.

C. Drive: Regenerative.

D. Quantity: Two.

E. Stops: Four.

F. Openings: Front.

G. Travel: As indicated.

H. Rated Capacity: 3,500-pounds.

I. Rated Speed: 150-250 feet per minute (fpm).

J. Clear Inside Dimensions:
   1. Passenger Elevator: 6'-5" wide x 5'-5" deep or as standard with elevator manufacturer based on specified capacity and indicated configurations.
   2. Elevator shall accommodate an ambulance stretcher shall comply with CBC Section 3002.4.1a through 3002.4.7a. Contractor and elevator manufacturer shall guarantee that the clear inside dimensions comply with CBC Section 3002.4.1a.

K. Cab Height: 9'-9"

L. Clear Cab Height under Suspended Ceiling: Manufacturer's standard based on cab finish flooring and dropped ceiling installed.

M. Entrance Type and Width: Single side doors 3'-6".

N. Entrance Height: 7'-0"

O. Main Power Supply: Refer to Electrical Drawings for voltage, three-Phase, with a separate equipment grounding conductor.

P. Car Lighting Power Supply: 120 Volts, Single-phase, 15 Amp, 60 Hz.

Q. Signal Fixtures: Manufacturer's standard.

R. Controller Location: Machine room.

S. Automatic Recovery Unit: Provide manufacturer's standard electrical equipment to permit return of cab to the first floor and open doors until normal power is restored.

T. Performance:

1. Car Speed: + 3% of contract speed under any loading condition or direction of travel.
2. Car Capacity: Safely lower, stop and hold up to 120% of rated load.
3. Ride Quality:
   a. Vertical Vibration (maximum): 20 mg
   b. Horizontal Vibration (maximum): 12 mg
   c. Vertical Jerk (maximum): 4.59 +/- 1.0 ft./ sec3
   d. Acceleration/Deceleration (maximum): 2.62 ft./ sec2
   e. In Car Noise: 55 – 60 dB(A)
   f. Stopping Accuracy: _ 0.375 in. max., _ 0.25 in. typical.
   g. Re-leveling Distance: +/- 0.5 in.

U. Operation: Simplex Operation. Using a microprocessor-based controller, operation shall be automatic by means of the car and hall buttons. If all calls in the system have been answered the car shall park at the last landing served.

V. Operation Features:
1. Full-Automatic Operation.
2. Anti-nuisance.
3. Fan and Light Protection.
4. Load Weighing Bypass.
5. Independent Service.
6. Firefighter's Service Phase I and Phase II.
7. Top of Car Inspection.
8. Zoned Car Parking.
9. Manual Rescue Operation (MRO).
10. Relative System Response Dispatching.

W. Door Control Features:
1. Door control to open doors automatically when car arrives at a landing in response to a normal hall or car call.
2. Elevator doors shall be provided with a reopening device that will stop and reopen the car door(s) and hoist way door(s) automatically should the door(s) become obstructed by an object or person. Door protection shall consist of a two-dimensional, multi-beam array projecting across the car door opening.
3. Door nudging operation shall occur if doors are prevented from closing for an adjustable period.
4. Card reader access control integration.

X. Provide equipment complying with CBC seismic requirements.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 SUBMITTALS

A. General: Comply with Section 013300 "Submittal Procedures."

B. Product Data: Submit manufacturer's product data for each system proposed for use. Include the following:
   1. Signal and operating fixtures, operating panels and indicators.
   2. Cab design, dimensions and layout.
   3. Hoist way door and frame details.
   4. Electrical characteristics and connection requirements.
   5. Expected heat dissipation of elevator equipment in control room space and machine space (BTU).
   6. Color selection chart for cab finishes.

C. Shop Drawings: Submit approval layout drawings. Include the following:
   1. Car, guide rails, buffers and other components in hoist way.
   2. Maximum rail bracket spacing.
   3. Maximum loads imposed on guide rails requiring load transfer to building structure.
   4. Clearances and travel of car.
   5. Clear inside hoist way and pit dimensions.
   6. Location and sizes of access doors, hoist way entrances and frames.

D. Operations and Maintenance Manuals: Provide manufacturer's standard operations and maintenance manual.

E. Deferred Submittal: For guide rails and brackets. Drawings and calculations to be stamped and signed by an engineer registered in the State of California and approved by DSA.

1.5 QUALITY ASSURANCE

A. Manufacturer: Elevator manufacturer shall be ISO 9002 certified.

B. Installer: Elevators shall be installed by the manufacturer.

C. Permits, Inspections and Certificates: Obtain and pay for required Inspections and permits as required by the elevator inspection authority, and make such tests as are called for by the regulations or such authorities. These tests shall be made in the presence of such authorities or their authorized representatives.

D. Finishes shall be approved by the Contractor for weight limitations as required by Code, in a timely manner to not delay construction and installation.

1.6 DELIVERY, STORAGE AND HANDLING

A. General: Material and equipment shall be suitably protected against corrosion, dirt, mechanical damage, weather and chemical damage before and during installation as recommended by the manufacturer.
   1. Replace defective and damaged equipment and materials at no additional cost

1.7 MAINTENANCE AND SERVICE

A. Maintenance service consisting of regular examinations and adjustments of the elevator equipment shall be provided for a period of 12 months after the elevator has been turned over for the Owner's use. Work shall be performed by competent employees during regular working hours of regular working days and shall include emergency 24-hour callback service. This service shall not cover adjustments, repairs or replacement of parts due to negligence, misuse, abuse or accidents caused by persons other than the elevator contractor. Only genuine parts and supplies as used in the manufacture and installation of the original equipment shall be provided.

B. The periodic lubrication of elevator components shall not be required, including: Sheaves, Rails, Belts, Ropes, Car and CWT guides, etc.

C. The elevator control system shall:
1. Provide in the controller the necessary devices to run the elevator in inspection operation.
2. Provide on top of the car the necessary devices to run the elevator in inspection operation.
3. Provide in the controller an emergency stop switch. This emergency stop switch when opened disconnects power from the brake and prevents the motor from running.
4. Provide in the event of a power outage, means from the controller to electrically lift and control the elevator brake to safely bring the elevator to the nearest available landing.
5. Provide the means from the controller to reset the governor over speed switch and trip the governor.
6. Provide the means from the controller to reset the emergency brake when set because of an unintended car movement or ascending car over speed.
7. Provide the means from the controller to reset elevator earthquake operation.
8. Provide system capabilities to enable a remote expert to create a live, interactive connection with the elevator system to enable the following functions:
    a. Remotely diagnose elevator issues with a remote team of experts.
    b. Remotely return an elevator to service.
    c. Provide real-time status updates via email.
    d. Remotely make changes to selected elevator functions including:
        1) Control building traffic: Restrict floor access, remove car from group operation, shut down elevator, select up peak/down peak mode, activate independent service.
        2) Conserve energy: Activate cab light energy save mode, activate fan energy save mode, shut down car(s).
        3) Improve passenger experience: Extend door open times, change parking floor, activate auto car full, activate anti-nuisance, advance door opening, door nudging, extend specific floor extended opening time, release trapped passengers.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

A. Otis "Gen3 Edge" or approved equal.

2.2 GENERAL REQUIREMENTS

A. Elevator system shall consist of the following components:

B. Controller located entirely inside the hoist way.

C. An AC gearless machine using embedded permanent magnets mounted at the top of the hoist way.

D. Polyurethane coated steel belts for elevator hoisting purposes. Polyurethane coated steel belts shall comply with ASME A17.1-2010 Safety Code for Elevators and Escalators and shall have passed the test requirements of UL 62, Flexible Cords and Cables UL 1581, Reference Standard for Electrical Wires, Cables and Flexible Codes with a FT-1 rating without the need for fire sprinklers in the hoist way.

E. Regenerative drive that captures normally wasted energy and feeds clean power back into the building's power grid.

F. LED lighting in ceiling lights and elevator fixtures.

G. Sleep mode operation for LED ceiling lights and car fan.

2.3 EQUIPMENT: SERVICE CABINET

A. Provide and install a metal parts cabinet in the machine room.
   1. The parts cabinet shall include items which are frequently used for minor repairs.
   2. This inventory shall be maintained throughout the warranty period and any subsequent maintenance agreements moving forward.
   3. Any parts removed from the cabinet will be replaced as fast as reasonable but not more than 30 days from the date removed.

2.4 EQUIPMENT: CONTROLLER COMPONENTS

A. Controller: Provide microcomputer-based control system shall be provided to perform the functions.
   1. All high voltage (110V or above) contact points inside the controller shall be protected from accidental contact when the controller doors are open.
   2. Controller shall be separated into two distinct halves - Motor Drive side and Control side. High voltage motor power conductors shall be routed to be physically segregated from the rest of the controller.
   3. Field conductor terminations points shall be segregated; high voltage (>30-volts DC and 110-VAC,) and low voltage (< 30-volts DC)

4. Controllers shall be designed and tested for Electromagnetic Interference (EMI) immunity according to the EN 12016 (May 1998): "EMC Product Family Standards for lifts, escalators, and passenger conveyors Part 2 – immunity"

B. Drive: Provide Variable Voltage Variable Frequency AC drive system to develop high starting torque with low starting current.

2.5 EQUIPMENT: MACHINE AND GOVERNOR

A. Machine: AC gearless machine, with a synchronous permanent-magnet motor, dual solenoid service and emergency disc brakes, mounted at the top of the hoist way.

B. Governor: Friction type over-speed governor rated for the duty of the elevator.

C. Buffers, Car and Counterweight: Polyurethane buffers.

D. Hoist way Operating Devices:
1. Emergency stop-switch in the pit
2. Terminal stopping switches.

E. Positioning System: Consists of magnets and proximity switches.

F. Guide Rails and Attachments: Steel rails with brackets and fasteners.

G. Coated Steel Belts: Polyurethane coated belts with high-tensile-grade, zinc-plated steel cords and a flat profile on the running surface and the backside of the belt. Driving sheaves and deflector sheaves shall have a crowned profile to ensure center tracking of the belts. A continuous 24/7 monitoring system using resistance-based technology shall be installed to continuously monitor the integrity of the coated steel belts and provide notice of belt wear.

H. Governor Rope: Steel consisting of at least eight strands wound about a sisal core center.

I. Fascia: Galvanized sheet steel at the front of the hoist way.

2.6 EQUIPMENT: HOISTWAY ENTRANCES

A. Hoist Way Entrances:
1. Frames: Entrance frames shall be of bolted construction for complete one-piece unit assembly. Frames shall be securely fastened to fixing angles mounted in the hoist way and shall be of UL fire rated steel.
2. Sills shall be extruded aluminum.
3. Doors: Entrance doors shall be of hollow metal construction with vertical internal channel reinforcements.
4. Fire Rating: Entrance and doors shall be UL fire rated for 1-1/2 hour.
5. Entrance Finish: Satin stainless steel.
6. Entrance Marking Plates: Entrance jambs shall be marked with 4-inch x 4-inch plates having raised floor markings with Braille located underneath the floor marking. Marking plates shall be provided on both sides of the entrance.

7. Sight Guards: Provide black sight guards.

2.7 EQUIPMENT: CAR COMPONENTS

A. Car Frame and Safety: Provide car frame bracing to support the platform and car enclosure. Car safety shall be integral to the car frame and shall be Type B, flexible guide clamp type.

B. Cab: Steel cab with removable vertical panels. Panel finish to be selected by the Architect.

C. Car Front: Satin stainless steel.

D. Car Door Finish: Satin stainless steel.

E. Ceiling Type: Ceiling panels with LED downlights. Material and finish to be selected by the Architect.

F. Emergency Car Lighting: Emergency power unit employing a 6-volt sealed rechargeable battery and totally static circuits to illuminate the elevator car in the event of building power failure.

G. Fan: One speed 120-VAC fan mounted to the ceiling to facilitate in-car air circulation, meeting A17.1 requirement. The fan shall be rubber mounted to prevent transmission of structural vibration and shall include a baffle to diffuse audible noise. A switch shall be provided in the car operating panel to control the fan.

H. Handrail: Provide on the rear and side walls of the car enclosure. Handrails shall be 3/8-inch x 2-inch flat tubular handrail with a satin stainless-steel finish.

I. Threshold: Extruded aluminum.

J. Emergency Exit Contact: Provide an electrical contact on the car top exit.

K. Guides: Car guides shall have 3-inch diameter roller guides at top and bottom and the counterweight shall have slide type guides at the top and bottom.

L. Platform: Metal with load weighing device mounted on the belts at the top of the hoist way.

M. Certificate Frame: Satin stainless steel.

N. LED ceiling lights and the fan shall automatically shut off when the system is not in use and be powered back up after a passenger calls the elevator and pushes a hall button.

O. Provide Doorguard “Cab Liner” or approved equal elevator cab protection system consisting of 1-inch Class A fire-rated panels with foam substrate laminated with .060-inch-thick Acrylic/PVC surface in color selected by the Architect from manufacturer’s standards. Provide locking tools as required for installation and removal. Store protection pads where directed by the Owner’s Representative.

P. Floor: Resilient flooring as selected by the Architect.

2.8 EQUIPMENT: SIGNAL DEVICES AND FIXTURES

A. Car Operating Panel: Provide car operating panel with all push buttons, key switches, and message indicators for elevator operation. The car operating panel shall have a satin stainless-steel finish.
   1. Elevator Control Buttons: Control buttons shall comply with CBC Section 11B-407.2. Buttons shall be a minimum 3/4-inch in size and shall be raised 1/8-inch above the surrounding surface. Control buttons shall be illuminated and have square shoulders. Control buttons shall be designated by a 5/8-inch minimum raised characters and symbols that comply with CBC Section 11B-703.2 immediately left of the control button. Contracted Grade 2 Braille complying with CBC Section 11B-703.3 shall be located immediately below the numeral, character, or symbol. The raised characters and symbols shall be white on a black background.
   2. The car operating panel shall be equipped with the following features:
   3. Raised markings and Braille to the left-hand side of each push button.
   4. Car position indicator at the top of, and integral to the car operating panel.
   5. Door open and door close buttons.
   6. Inspection key-switch.
   7. Elevator data plate marked with elevator capacity and car number.
   8. Emergency Communication System: Provide system that complies with ASME A17.1 and the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines (ADAAG)." On activation, system dials preprogrammed number of monitoring station and identifies elevator location to monitoring station. System provides two-way voice communication without using a handset and provides visible signals that indicate when system has been activated and when monitoring station has responded. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.
   9. Landing passing signal. A chime bell shall sound in the car to signal that the car is either stopping at or passing a floor served by the elevator.
   10. In car stop switch (toggle or key).
   11. Firefighter's hat.
   12. Firefighters Phase II Key Switch.
   13. Call cancel button.

B. Car Position Indicator: A digital LED car position indicator shall be integral to the car operating panel.

C. Hall Fixtures: Wall mounted hall fixtures shall be provided with necessary push buttons and key switches for elevator operation. Wall mounted hall fixtures shall have a polycarbonate face plate that is shatterproof and impact resistant.
   1. Hall Call Buttons: Hall call buttons shall comply with CBC Section 11B-407.2. Buttons shall be a minimum 3/4-inch in size and shall be raised 1/8-inch above the surrounding surface. Hall call buttons shall be internally illuminated with a white light over the entire surface.

D. Car Lantern and Chime: A directional lantern visible from the corridor shall be provided in the car entrance. When the car stops and the doors are opening, the lantern shall

indicate the direction in which the car is to travel, and a chime will sound. The chime will sound once for up and twice for down.

PART 3 - EXECUTION

3.1 PREPARATION

A. Take field dimensions and examine conditions of substrates, supports, and other conditions under which this work is to be performed. Do not proceed with work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Install elevator components in accordance with manufacturer's instructions.

B. Properly locate guide rails and related supports at locations in accordance with manufacturer's recommendations and shop drawings. Anchor to building structure using isolation system to minimize transmission of vibration to structure.

C. Fasten hoist way frames to fixing angles mounted in the hoist way.

D. Lubricate operating system components in accordance with manufacturer's recommendations.

E. Perform final adjustments and service prior to Substantial Completion.

3.3 DEMONSTRATION

A. Make a final check of each elevator operation with the Architect and Owner's representative present prior to turning each elevator over for use. Verify that control systems and operating devices are functioning properly.

3.4 CONSTRUCTION WASTE MANAGEMENT

A. General: Comply with the requirements of Section 01 74 19 for removal and disposal of construction debris and waste.

B. Separate and recycle waste materials to the maximum extent possible.

END OF SECTION

SECTION 149182 - TRASH CHUTES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Waste chutes.
a. Waste doors.

1.2 DEFINITIONS

A. Access Door: Door other than an intake or discharge door that penetrates the chase wall for service access to devices in the chase.

B. Chase: The shaft that encloses a chute.

C. Discharge Door: Door or hatch at the bottom of a chute, through which materials exit the chute.

D. Intake Door: Door or hatch that penetrates the chase wall and chute, and through which materials are fed into the chute.

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:
1. Include plans, elevations, sections, and mounting and attachment details.
2. Include diagrams for power, signal and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plan(s) and other details, drawn to scale and coordinated with each other, using input from installers of the items involved.

B. Product Certificates: For each type of chute.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For chutes to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
   1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
   1. Wilkinson Hi-Rise, LLC.
      a. Jeff Menke
         Terra Pacific Waste Management
         2081 Business Center Drive #230
         Irvine, CA 92612
         800-765-1208x707
         jmenke@terrapacificwaste.com

2.2 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and California Building Code, Chapter 11B.

B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing and inspecting agency, for fire-protection ratings indicated.
   1. Test Pressure: Test at atmospheric (neutral) pressure according to NFPA 252 or UL 10B.
   2. Intake Doors: Labeled, 1-1/2-hour fire-resistance rated with 30-minute temperature rise of 250 deg F.
   3. Access Doors: Labeled, 1-1/2-hour fire-resistance rated with 30-minute temperature rise of 250 deg F.

C. Discharge-Door Assemblies: Fire-resistive door construction according to NFPA 252 or UL 10B requirements for fire-rated door assemblies.

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.

E. Standard: Provide chutes complying with NFPA 82.

F. Door Management System: Internet-ready control panel for electrically interlocked chute doors.

2.3 WASTE CHUTES

A. Chute Metal: Aluminum-coated, cold-rolled, commercial steel sheet; ASTM A463/A463M, Type 1, with not less than T1-40 coating.
   1. Thickness: 16 gauge.

B. Chute Size: 24-inch diameter.

2.4 WASTE CHUTE DOORS

A. Intake-Door Assemblies: ASTM A240/A240M, Type 430, stainless steel both inside and outside self-closing units with positive latch and latch handle, with stainless steel trim; constructed as required for performance requirements indicated; and with frame suitable for the enclosing chase construction.
   1. Door Type: Type as indicated on Drawings.
   2. Size: Manufacturer's standard recommended size for door type, chute type, and diameter indicated.
   3. Finish: Manufacturer's standard satin or ASTM A480/A480M No. 3 directional polish.
   4. Accessible Automatic Door Operating System: Manufacturer's standard system complying with applicable provisions of the cited accessibility standard.
   5. Electrical Interlocks: Interlock system that is energized by opening one intake door; remaining intake doors automatically lock when system is energized.
   6. Baffles: Rubber backdraft baffles at each intake.

B. Discharge-Door Assemblies: Aluminum-coated steel; direct vertical-discharge type, inclined, and horizontally closing and latching; constructed as required for performance requirements indicated; and equipped with fusible links that cause doors to close in the event of fire.

C. Detector System: Heat- and smoke-detecting interlock system with temperature-rise elements that locks chute doors when temperature in chute reaches a predetermined, adjustable temperature.

D. Access-Door Assemblies: Manufacturer's standard ASTM A240/A240M, Type 302/304, stainless steel doors with trim; constructed as required for performance requirements indicated; with frame suitable for the enclosing chase construction; in satin or ASTM A480/A480M No. 3 directional polish finish; equipped with cylinder locks that release latch with keys that are removable only when cylinder is locked.

2.5 ACCESSORIES

A. Chute Fire Sprinklers: NFPA 13; manufacturer's standard, recessed, automatic, NPS 1/2 sprinklers; ready for piping connections.

B. Flushing Spray Unit: NPS 3/4 spray-head unit located in chute above highest intake door, ready for hot-water piping connection, and with access door for spray-head and piping maintenance.

C. Sanitizing Unit: NPS 3/4 disinfecting and sanitizing spray-head unit located in chute above highest intake door, including 1-gal. tank and adjustable proportioning valve with bypass for manual control of sanitizing and flushing operation, ready for hot-water piping connection, and with access door for spray-head and piping maintenance.

D. Intake-Door Baffles: Rubber baffles, 1/8 inch thick.

E. Air compressor for pneumatic systems.

2.6 FABRICATION

A. Factory-assemble chutes to greatest extent practicable.

B. Roof Vent: Extend vent to height above roofing surface as indicated on Drawings. Equip vent with full insect screening and metal explosion-release cap. Fabricate with roof-deck flange, counterflashing, and clamping ring of nonferrous metal compatible with chute metal.

C. Chute Fire Sprinklers: Install internally within chute, recessed out of the chute area through which material travels, and according to NFPA 13.

D. Equipment Access: Fabricate chutes with access for maintaining equipment located within the chute, such as flushing and sanitizing units, fire sprinklers, and plumbing and electrical connections.

E. Sound Dampening: Manufacturer's standard sound-deadening coating on exterior of chute and sound-insulating wrap around exterior of chute and intake assemblies.

F. Sound Isolation: Manufacturer’s recommended isolators to be installed under the chute floor mounts. (Minimum requirement: Mason Super W or approved equal).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install and test chutes before installing enclosing chase construction.

B. Install chutes according to NFPA 82 and manufacturer's written instructions. Assemble components with tight, nonleaking joints. Anchor chutes securely to supporting structure to withstand impacts and stresses. Install chute and components to maintain fire-resistive performance of chute and the enclosing chase construction.

C. Install chutes plumb, without obstructions that might prevent materials from free falling within chutes.

D. Anchor flanges of chute vents to roof curbs before installing roofing and flashing. Install chute-vent counterflashing after roofing and roof-penetration flashing are installed.

E. Intake and Discharge Doors: Interface door units with throat sections of chutes for safe, snag-resistant, sanitary depositing of materials in chutes.
   1. Interconnect sanitizer control with door interlock system.

F. Electrical Interlock System: Install according to applicable NECA 1 recommendations.

G. Test and adjust chute components after installation. Operate doors, locks, and interlock systems to demonstrate that hardware operates properly and smoothly and electrical wiring is connected correctly.

H. Test heat- and smoke-sensing devices for proper operation.

3.2 ADJUSTING

A. Adjust doors for smooth and balanced movement.

B. Operate sanitizing unit through one complete cycle of chute use and cleanup, and replenish chemicals or cleaning fluids in unit containers.

3.3 CLEANING

A. After completing chase enclosure, clean exposed surfaces of chute system's components. Do not remove labels of testing and inspecting agencies.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain each chute and related equipment.

END OF SECTION

SECTION 211313 – WET-PIPE SPRINKLER 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. Pipes, fittings, and specialties.
2. Sprinklers.
3. Alarm devices.
4. Manual control stations.
5. Control panels.
6. Pressure gages.

1.3 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175-psig maximum.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For wet-pipe sprinkler systems.

1. Include plans, elevations, sections, and attachment details.
2. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Domestic water piping.
2. Compressed air piping.

3. HVAC hydronic piping.
4. Items penetrating finished ceiling include the following:

    a. Lighting fixtures.
    b. Air outlets and inlets.

B. Qualification Data: For qualified Installer and NICET certified technician.

C. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wet-pipe sprinkler systems and specialties to include in emergency, operation, and 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. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on the Project.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.9 FIELD CONDITIONS

A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by District or others unless permitted under the following conditions and then only after arranging to provide full-time fire watch according to requirements indicated:

1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of sprinkler service.
2. Do not proceed with interruption of sprinkler service without Construction Manager's written permission.

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. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13.

C. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

2.2 SPECIALTY VALVES

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

B. Pressure Rating:

1. Standard-Pressure Piping Specialty Valves: 175-psig minimum.

C. Body Material: Cast or ductile iron.

D. Size: Same as connected piping.

E. End Connections: Flanged or grooved.

2.3 STEEL PIPE AND FITTINGS

A. Standard-Weight, Black-Steel Pipe: ASTM A 53/A 53M. Pipe ends may be factory or field formed to match joining method. Minimal wall thickness of pipes with threaded ends shall be Schedule 40. Pipe used on the exterior of the building shall be primed and finished with weather-resistant paint.

B. Schedule 10 and Schedule 40, Black-Steel Pipe: ASTM A 135/A 135M or ASTM A 795/A 795M, Schedule 10 for pipes 2 ½ inches and larger; and Schedule 40 for

pipes 2 inches and less; and NFPA 13-specified wall thickness in NPS 6 to NPS 10, plain end. Pipe used on the exterior of the building shall be primed and finished with weather-resistant paint.

C. Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends. Fittings used on the exterior of the building shall be primed and finished with weather-resistant paint.

D. Steel Couplings: ASTM A 865/A 865M, threaded. Couplings used on the exterior of the building shall be primed and finished with weather-resistant paint.

E. Malleable- or Ductile-Iron Unions: UL 860.

F. Cast-Iron Flanges: ASME 16.1, Class 125.

G. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

1. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8-inch-thick.

a. Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.
b. Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.

2. Metal, Pipe-Flange Bolts and Nuts: Carbon steel unless otherwise indicated.

H. Grooved-Joint, Steel-Pipe Appurtenances:

1. Pressure Rating: 175-psig minimum.
2. Painted, Uncoated Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting, with dimensions matching steel pipe.
3. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.4 SPRINKLER PIPING SPECIALTIES

A. Sprinkler Inspector's Test Fittings:

1. Standard: UL's "Fire Protection Equipment Directory."
2. Pressure Rating: 175-psig minimum.
3. Body Material: Cast- or ductile-iron housing with sight glass.
4. Size: Same as connected piping.
5. Inlet and Outlet: Threaded.

2.5 SPRINKLERS

A. Listed in UL's "Fire Protection Equipment Directory."

B. Pressure Rating for Automatic Sprinklers: 175-psig minimum.

C. Automatic Sprinklers with Heat-Responsive Element:

1. Nonresidential Applications: UL 199.

D. Sprinkler Finishes: brass, painted white and corrosion resistant.

E. Special Coatings: corrosion-resistant finish for exterior sprinklers.

F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: white concealed type sprinkler.
2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

G. Sprinkler Guards:

1. Standard: UL 199.
2. Type: Wire cage with fastening device for attaching to sprinkler.

H. Oversize Ring: Provide 2-inch oversize ring or adapter for sprinkler heads through the ceiling tile to allow for free movement of at least 1 inch in all directions in accordance with ASCE 7-16 Section 13.5.6.2.2(e).

2.6 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Electrically Operated Alarm Bell:
1. Power: 120-V AC.
2. Standard: UL 464.
3. Type: Vibrating, metal alarm bell.
4. Size: 10-inch diameter.
5. Finish: Red-enamel factory finish, suitable for outdoor use.
6. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application

C. Water-Flow Indicators:

1. Standard: UL 346.
2. Water-Flow Detector: Electrically supervised.
3. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
4. Type: Paddle operated.
5. Pressure Rating: 250 psig.
6. Design Installation: Horizontal or vertical.

D. Valve Supervisory Switches:

1. Standard: UL 346.
2. Type: Electrically supervised.
3. Components: Single-pole, double-throw switch with normally closed contacts.
4. Design: Signals that controlled valve is in other than fully open position.
5. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application

2.7 PRESSURE GAGES

A. Standard: UL 393.

B. Dial Size: 3-1/2- to 4-1/2-inch diameter.

C. Pressure Gage Range: 0- to 250-psig minimum.

D. Label: Include "WATER" label on dial face.

PART 3 - EXECUTION

3.1 SERVICE-ENTRANCE PIPING

A. Connect sprinkler piping to water-service piping for service entrance to building.

B. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.2 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.

1. Deviations from approved working plans for piping require written approval from DSA. File written approval with Construction Manager before deviating from approved working plans. This does not include minor revisions for the purpose of coordination with other trades.
2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies. Install piping offsets as required for coordination with other trades.

B. Connect standpipe distribution system piping to water-service piping for service entrance to building. Comply with requirements for exterior piping in Section 331415 "Site Water Distribution Piping" for exterior piping.

C. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.

D. Install standpipe systems in accordance with NFPA 14 requirements.

E. Install seismic restraints on piping as indicated on Drawings.

F. Use fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

H. Install sprinkler piping with drains for complete system drainage.

I. Install alarm devices in piping systems.

J. Install pressure gauges on riser. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gauges to permit removal, and install where they are not subject to freezing.

K. Fill sprinkler system piping with water.

L. Install sleeves for piping penetrations of walls, ceilings, and floors.

M. Install sleeve seals for piping penetrations of concrete walls and slabs.

N. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.3 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. 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 pipes, tubes, and fittings before assembly.

D. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

F. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

G. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

3.4 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

3.5 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center or 1/4 point of acoustical ceiling panels.

B. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

3.6 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.7 FIELD QUALITY CONTROL

A. Perform the following tests and inspections in the presence of the Project Inspector. Notify Project Inspector no fewer than two days in advance of testing.

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safety. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Coordinate with fire-alarm tests. Operate as required.
6. Verify that equipment hose threads are same as local fire department equipment.

B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.8 CLEANING

A. Clean dirt and debris from sprinklers.

B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.9 PIPING SCHEDULE

A. Piping between Fire Department Connections and Check Valves: Standard-weight steel pipe with grooved ends, grooved-end fittings, grooved-end-pipe couplings, and grooved joints.

B. Standard-pressure, wet-pipe sprinkler system, shall be one of the following:

1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Schedule 10 black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.10 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Concealed sprinklers as indicated.
3. Special Applications: Quick-Response sprinklers where indicated.

B. Provide sprinkler types in subparagraphs below with finishes indicated.
1. Concealed Sprinklers: white.
2. Upright, Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.
3. Corrosion-resistant finish where exposed to the exterior.

END OF SECTION

SECTION 220517 – SLEEVES AND SLEEVE SEALS 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. Sleeves.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.

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.

B. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

C. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

2.2 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. Metraflex Company (The).
4. Pipeline Seal and Insulator, Inc.
5. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Presealed Systems.

B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.4 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. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch (25-mm) annular clear space between piping and concrete slabs and walls.
   1. Sleeves are not required for core-drilled holes.

C. 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.

D. 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."

E. 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-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a 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.

3.4 SLEEVE AND SLEEVE-SEAL 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. Exterior Concrete Walls below Grade:
      a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel wall sleeves with sleeve-seal system.
         1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
   3. Concrete Slabs-on-Grade:
      a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel wall sleeves with sleeve-seal system.
         1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.

4. Interior Partitions:
   a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel-pipe sleeves.

END OF SECTION

SECTION 220518 – ESCUTCHEONS 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. Escutcheons.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

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 insulated piping and with OD that completely covers opening.
   1. Escutcheons for New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
      b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
      c. Insulated Piping: One-piece, stamped-steel type.
      d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
      e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.

f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
g. Bare Piping in Unfinished Service Spaces: One-piece, cast-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

SECTION 220519 – METERS AND GAGES 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. Bimetallic-actuated thermometers.
   2. Liquid-in-glass thermometers.
   3. Thermowells.
   4. Dial-type pressure gages.
   5. Test plugs.

B. Related Sections:
   1. Division 22 Section 221413 "Facility Water Distribution Piping" for domestic water meters and combined domestic and fire-protection water-service meters outside the building.
   2. Division 22 Section 221116 " Domestic Water Piping" for water meters inside the building.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

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 BIMETALLIC-ACTUATED THERMOMETERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Trerice, H. O. Co.
   2. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
   3. Weiss Instruments, Inc.

B. Standard: ASME B40.200.

C. Case: Liquid-filled and sealed type(s); stainless steel with 3-inch (76-mm) nominal diameter.

D. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F (deg C).

E. Connector Type(s): Union joint, rigid, back, and rigid, bottom, with unified-inch screw threads.

F. Connector Size: 1/2 inch (13 mm), with ASME B1.1 screw threads.

G. Stem: 0.25 or 0.375 inch (6.4 or 9.4 mm) in diameter; stainless steel.

H. Window: Plain glass.

I. Ring: Stainless steel.

J. Element: Bimetal coil.

K. Pointer: Dark-colored metal.

L. Accuracy: Plus or minus 1 percent of scale range.

2.2 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Trerice, H. O. Co.
      b. Weiss Instruments, Inc.
      c. Or approved equal.
   2. Standard: ASME B40.200.
   3. Case: Cast aluminum; 7-inch (178-mm) nominal size unless otherwise indicated.
   4. Case Form: Straight unless otherwise indicated.
   5. Tube: Glass with magnifying lens and blue or red organic liquid.
   6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F (deg C).
   7. Window: Glass.

8. Stem: Aluminum and of length to suit installation.
   a. Design for Thermowell Installation: Bare stem.
9. Connector: 1-1/4 inches (32 mm), with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.3 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.
   4. Material for Use with Steel Piping: CRES.
   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.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.4 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. AMETEK, Inc.; U.S. Gauge.
      b. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
      c. Weiss Instruments, Inc.
   2. Standard: ASME B40.100.
   3. Case: Liquid-filled type(s); cast aluminum or drawn steel; 4-1/2-inch (114-mm) nominal diameter.
   4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
   5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
   6. Movement: Mechanical, with link to pressure element and connection to pointer.
   7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa).
   8. Pointer: Dark-colored metal.
   9. Window: Glass.
   10. Ring: Metal.
   11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.5 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Trerice, H. O. Co.
   2. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
   3. Weiss Instruments, Inc.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/4 (DN 8) or NPS 1/2 (DN 15), ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F (3450 kPa at 93 deg C).

F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

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 direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

H. Install remote-mounted pressure gages on panel.

I. Install valve and snubber in piping for each pressure gage for fluids.

J. Install test plugs in piping tees.

K. Install thermometers in the following locations:
1. Inlet and outlet of each water heater.

L. Install pressure gages in the following locations:
1. Building water service entrance into building.
2. Inlet and outlet of each pressure-reducing valve.
3. Suction and discharge of each domestic water 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.

3.3 ADJUSTING

A. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each domestic water heater shall be one of the following:
1. Liquid-filled, bimetallic-actuated type.
2. Direct-mounted, metal-case, vapor-actuated type.
3. Industrial-style, liquid-in-glass type.
4. Direct-mounted, light-activated type.
5. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.

B. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Domestic Cold-Water Piping: 0 to 150 deg F (Minus 20 to plus 70 deg C).

B. Scale Range for Domestic Hot-Water Piping: 0 to 250 deg F (0 to 150 deg C).

3.6 PRESSURE-GAGE SCHEDULE

A. Pressure gages at discharge of each water service into building shall be the following:
1. Liquid-filled, direct -mounted, metal case.
2. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.

B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be the following:
1. Liquid-filled Solid-front, pressure-relief, direct-mounted, metal case.
2. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.

C. Pressure gages at suction and discharge of each domestic water pump shall be the following:
   1. Liquid-filled, direct-mounted, metal case.
   2. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Water Service Piping: 0 to 160 psi (0 to 1100 kPa).

B. Scale Range for Domestic Water Piping: 0 to 160 psi (0 to 1100 kPa).

END OF SECTION

SECTION 220523.12 – BALL 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.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.
1. Certification that products comply with NSF 61 Annex G and California Assembly Bill AB1953 and NSF 372.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, and soldered ends.
3. Set ball valves open to minimize exposure of functional surfaces.

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 operating handles or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:
1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.18 for solder-joint connections.
3. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 Annex G and California Assembly Bill AB1953 and NSF 372 for valve materials for potable-water service.

D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Actuator Types:
1. Hand lever: For quarter-turn valves smaller than NPS 4.

H. Valves in Insulated Piping:
1. Include 2-inch stem extensions.
2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
3. Memory stops that are fully adjustable after insulation is applied.

2.2 BRONZE BALL VALVES

A. Two-Piece, Bronze Ball Valves with Full Port and Stainless-Steel Trim:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Conbraco Industries, Inc.
b. Milwaukee Valve Company.
c. NIBCO INC.
d. Or equal.
2. Description:
a. Standard: MSS SP-110.
b. CWP Rating: 600 psig.
c. Body Design: Two piece.
d. Body Material: Bronze.
e. Ends: Threaded or soldered.
f. Seats: PTFE.

g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Full.

B. Three-Piece, Bronze Ball Valves with Full Port and Stainless-Steel Trim:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Conbraco Industries, Inc.
b. Milwaukee Valve Company.
c. NIBCO INC.
d. Or equal.
2. Description:
a. Standard: MSS SP-110.
b. CWP Rating: 600 psig.
c. Body Design: Three piece.
d. Body Material: Bronze.
e. Ends: Threaded.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Full.

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 valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

B. Select valves with the following end connections:
   1. For Copper Tubing, NPS 2 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: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
   3. For Copper Tubing, NPS 5 and Larger: Flanged ends.

3.4 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:
   1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
   2. Two-piece, bronze ball valves with full port and stainless-steel trim.
   3. Three-piece, bronze ball valves with full port and stainless-steel trim.

B. Pipe NPS 2-1/2 and Larger:
   1. Steel and Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
   2. Class 150, steel ball valves with full port.
   3. Class 150, iron ball valves.

END OF SECTION

SECTION 220523.14 – CHECK VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Bronze, lift check valves.
   2. Bronze, swing check valves.
   3. Iron, center-guided, spring-loaded check valves.

1.2 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene-diene terpolymer.

C. NBR: Nitrile butadiene rubber (also known as Buna-N).

1.3 ACTION SUBMITTALS

A. Product Data:
   1. Bronze, lift check valves.
   2. Bronze, swing check valves.
   3. Bronze, swing check valves, press ends.
   4. Iron, center-guided, spring-loaded check valves.

1.4 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, press connections, and weld ends.
   3. Set 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 stems or other components as lifting or rigging points unless specifically indicated for this purpose in manufacturer's instructions.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each type of valve from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Standards:
1. Domestic water piping check valves intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), requirements of authorities having jurisdiction, and NSF 61/NSF 372, or to be certified in compliance with NSF 61/NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

B. ASME Compliance:
1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.5 for flanges for metric standard piping.
3. ASME B16.18 for cast-copper solder joint.
4. ASME B16.22 for wrought copper solder joint.
5. ASME B16.51 for press joint.

C. AWWA Compliance: Comply with AWWA C606 for groove-end connections.

D. Provide bronze valves made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are unacceptable.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.3 BRONZE, SWING CHECK VALVES

A. Bronze, Swing Check Valves with Bronze Disc, Class 150:
1. Standard: MSS SP-80, Type 3.
2. CWP Rating: 300 psig (2070 kPa).
3. Body Design: Horizontal flow.
4. Body Material: ASTM B62, bronze.
5. Ends: Threaded or soldered. See valve schedule articles.
6. Disc: Bronze.

2.4 IRON, CENTER-GUIDED, SPRING-LOADED CHECK VALVES

A. Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat, Class 150:
   1. Standard: MSS SP-125.
   2. CWP Rating: 300 psig (2070 kPa).
   3. Body Material: ASTM A395/A395M or ASTM A536, ductile iron.
   4. Style: Compact wafer, spring loaded.
   5. Seat: Bronze.

B. Iron, Globe, Center-Guided Check Valves with Metal Seat, Class 150:
   1. Standard: MSS SP-125.
   2. CWP Rating: 300 psig (2070 kPa).
   3. Body Material: ASTM A395/A395M or ASTM A536, ductile iron.
   4. Style: Globe, spring loaded.
   5. Ends: Flange.
   6. Seat: Bronze.

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. Examine press fittings to verify they have been properly pressed.

F. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION OF VALVES

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Provide support of piping adjacent to valves such that no force is imposed upon valves.

C. Locate valves for easy access and where not blocked by equipment, other piping, or building components.

D. Install valves so that stems are horizontal or slope upward from centerline of pipe.

E. Install valves in position that does not project into aisles or block access to other equipment.

F. Install valves in position to allow full stem and manual operator movement.

G. Verify that joints of each valve have been properly installed and sealed to assure there is no leakage or damage.

H. Check Valves: Install check valves for proper direction of flow.
   1. Swing Check Valves: In horizontal position with hinge pin level.
   2. Check Valves: Center-guided type and plate type, in horizontal or vertical position, between flanges.
   3. Lift Check Valves: With stem upright and plumb.

I. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

J. Adhere to manufacturer's installation instructions. When soldering or brazing valves, do not heat valves above maximum permitted temperature. Do not use solder with melting point temperature above valve manufacturer's recommended maximum.

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 valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

B. End Connections:
   1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded, soldered, or press-end connections.
   2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flange or threaded.
   3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flange.
   4. For Groove End Tubing and Piping: Groove.

3.5 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 4 (DN 100) and Smaller:
   1. Bronze, swing check valves with bronze disc, Class 125, with soldered or threaded end connections.
   2. Bronze, swing check valves with press-end connections.

END OF SECTION

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. Section Includes:
1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Fastener systems.
5. Pipe stands.
6. Pipe positioning systems.
7. Equipment supports.

B. Related Sections:
1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:
1. Trapeze pipe hangers.
2. Metal framing systems.
3. Equipment supports.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.6 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: PR galvanized 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 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Cooper B-Line, Inc.
b. Flex-Strut Inc.
c. Unistrut Corporation; Tyco International, Ltd.
2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with in turned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Metallic Coating: Hot-dipped galvanized.
8. Paint Coating: Vinyl.
9. Plastic Coating: PVC.

2.4 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

C. High-Type, Single-Pipe Stand:
1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
2. Base: Stainless steel.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

D. High-Type, Multiple-Pipe Stand:
1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: One or more; plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

E. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.6 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.7 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.8 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
   1. Properties: Nonstaining, noncorrosive, and nongaseous.
   2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

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. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

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. Pipe Stand Installation:
   1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
   2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 061000 “Rough Framing" for curbs.

F. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

J. Install lateral bracing with pipe hangers and supports to prevent swaying.

K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65) and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

M. 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.

N. 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. 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.
      b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
   5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment support.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 099100 "Painting and Coating."

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 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 metal framing systems 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. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36 (DN 20 to DN 900), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
   3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 (DN 15 to DN 600) if little or no insulation is required.
   4. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4 (DN 15 to DN 100), to allow off-center closure for hanger installation before pipe erection.
   5. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8 (DN 20 to DN 200).
   6. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
   7. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
   8. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
   9. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8 (DN 10 to DN 200).
   10. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3 (DN 10 to DN 80).
   11. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
   12. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
   13. 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.

14. 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.
15. 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.
16. 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.
17. 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.
18. 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. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
   2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
   3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
   4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
   5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
   6. C-Clamps (MSS Type 23): For structural shapes.
   7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
   8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.

9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    a. Light (MSS Type 31): 750 lb (340 kg).
    b. Medium (MSS Type 32): 1500 lb (680 kg).
    c. Heavy (MSS Type 33): 3000 lb (1360 kg).
13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

L. 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.

M. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

N. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

O. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

P. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION

SECTION 220548 – VIBRATION AND SEISMIC CONTROLS 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. Restraint channel bracings. See Detail 5, sheet P5.01.
2. Restraint cables. See Detail 6, sheet P5.01.
3. Seismic-restraint accessories. See Details 5, 6, & 7, sheet P5.01.
4. Mechanical anchor bolts. See Detail 7, sheet P5.01.

1.3 DEFINITIONS

A. CBC: California Building Code.

B. ICC-ES: ICC-Evaluation Service.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
   2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required.

      a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
      b. Annotate to indicate application of each product submitted and compliance with requirements.

B. Shop Drawings:
   1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

B. Qualification Data: For professional engineer.

C. Welding certificates.

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the CBC unless requirements in this Section are more stringent.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPM 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 unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Assigned Seismic Use Group or Building Category as Defined in the CBC: II.

a. Component Importance Factor: 1.0.
b. Component Response Modification Factor: 2.5.
c. Component Amplification Factor: 2.5.

2. Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

a. 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 are subjected.

2.2 RESTRAINT CHANNEL BRACINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.
2. Hilti, Inc.
3. Mason Industries, Inc.

B. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.3 MECHANICAL ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.
2. Hilti, Inc.
3. Mason Industries, Inc.

B. 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.

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 of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. 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.

B. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

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 that provides 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: See sheet P5.01 for plumbing system attachment details.

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 221116 "Domestic Water Piping" 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 post connection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test 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.

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.

END OF SECTION

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. Warning signs and labels.
3. Pipe labels.
4. Stencils.
5. Valve tags.
6. Warning tags.

1.3 ACTION 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. Metal Labels for Equipment:
1. Material and Thickness: Brass, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. 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).
3. 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.
4. Fasteners: Stainless-steel rivets.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Green.
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.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.

B. Letter Color: White.

C. Background Color: Red.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).

E. 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).

F. 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.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Pre-coiled, semirigid plastic formed to partially cover 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.

2.4 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch (19 mm) for access panel and door labels, equipment labels, and similar operational instructions.

1. Stencil Material: Aluminum.
2. Stencil Paint: Exterior, gloss, alkyd enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1 unless otherwise indicated.

2.5 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.

2.6 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
   1. Size: Approximately 4 by 7 inches (100 by 178 mm).
   2. Fasteners: Brass grommet and wire.
   3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
   4. Color: Yellow background with black lettering.

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. Piping Color-Coding: Painting of piping is specified in Section 099123 "Interior Painting."

B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles, complying with ASME A13.1, on each piping system.
   1. Identification Paint: Use for contrasting background.
   2. Stencil Paint: Use for pipe marking.

C. 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.

D. Pipe Label Color Schedule:
   1. Low-Pressure, Compressed-Air Piping:
      a. Background Color: Blue.
      b. Letter Color: White.
   2. Domestic Water Piping:
      a. Background Color: Green.
      b. Letter Color: White.
   3. Sanitary Waste and Storm Drainage Piping:
      a. Background Color: Green.
      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 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. Cold Water: 1-1/2 inches (38 mm), round.
      b. Hot Water: 1-1/2 inches (38 mm), round.
      c. Low-Pressure Compressed Air: 1-1/2 inches (38 mm), round.
   2. Valve-Tag Color:

a. Cold Water: Green.
b. Hot Water: Green.
c. Low-Pressure Compressed Air: Blue.

3. Letter Color:
a. Cold Water: White.
b. Hot Water: White.
c. Low-Pressure Compressed Air: White.

3.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

SECTION 220593 – TESTING, ADJUSTING, AND BALANCING 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. Section Includes:
   1. TAB of domestic water system.
   2. TAB of plumbing equipment:
      a. Domestic water booster pumps.
      b. Domestic hot-water in-line circulation pumps.
      c. Domestic hot-water heaters.
   3. Pipe-leakage test verification.
   4. Testing, adjusting, and balancing of existing plumbing systems and equipment.

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 independent entity meeting qualifications to perform TAB work.

F. TDH: Total dynamic head.

1.4 PREINSTALLATION MEETINGS

A. TAB Conference: Conduct a TAB conference at after approval of the TAB strategies and procedures plan, to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.
   1. Minimum Agenda Items:
      a. The Contract Documents examination report.
      b. The TAB plan.
      c. Needs for coordination and cooperation of trades and subcontractors.
      d. Proposed procedures for documentation and communication flow.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report, as specified in Part 3.

C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures, as specified in "Preparation" Article.

D. System Readiness Checklists: Within 30 days of Contractor's Notice to Proceed, submit system readiness checklists, as specified in "Preparation" Article.

E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

F. Certified TAB reports.

G. Sample report forms.

H. 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.

1.6 QUALITY ASSURANCE

A. TAB Specialists Qualifications, Certified by AABC:
   1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
   2. TAB Technician: Employee of the TAB specialist and certified by AABC.

B. TAB Specialists Qualifications, Certified by NEBB:
   1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB.
   2. TAB Technician: Employee of the TAB specialist and certified by NEBB.

C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

D. ASHRAE 111 Compliance: Requirements in ASHRAE 111 applicable to analogous domestic water system and plumbing equipment balancing.

E. ASHRAE 188 Compliance: Comply with balancing and report requirements, Section 8.3 "Balancing."

F. Code and Authorities Having Jurisdiction Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

1.7 FIELD CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. 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.

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 installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, and balancing valves and fittings. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine approved submittals for plumbing systems and equipment.

D. Examine design data, including plumbing system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about plumbing system and equipment controls.

E. Examine equipment performance data, including pump curves.
   1. Relate performance data to Project conditions and requirements, including pump system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
   2. Calculate pump system-effect factors to reduce performance ratings of plumbing equipment when installed under conditions different from the conditions used to rate equipment performance. Compare results with the design data and installed conditions.

F. Examine system and equipment installations, and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

G. Examine test reports specified in individual system and equipment Sections.

H. Examine plumbing equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

I. Examine temporary and permanent strainers. Verify that temporary strainer screens used during system cleaning and flushing have been removed and permanent strainers are installed and clean.

J. Examine control valves for proper installation for their intended function of isolating, throttling, diverting, or mixing fluid flows.

K. Examine system pumps to ensure absence of entrained air in the suction piping.

L. Examine operating safety interlocks and controls on plumbing equipment.

M. 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 the following:
   1. Equipment and systems to be tested.
   2. Strategies and step-by-step procedures for balancing the systems.
   3. Instrumentation to be used.
   4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of plumbing systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
   1. Domestic Water System:
      a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed in accordance with applicable code and authority having jurisdiction.
      b. Water heaters are installed and functioning.
      c. Piping is complete and all points of outlet are installed.
      d. Water treatment is complete.
      e. Systems are flushed, filled, and air purged.
      f. Strainers are clean.
      g. Control valves are functioning in accordance with the sequence of operation.
      h. Shutoff and balance valves are 100 percent open.
      i. Booster- and hot-water circulating pumps are operational and proper rotation is verified.
      j. Pump gauge connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
      k. Variable-frequency controllers' startup is complete and safeties are verified.
      l. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system in accordance with the procedures contained in AABC's "National Standards for Total System Balance" and in this Section.

B. Cut insulation, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.
   1. Where holes for probes are required in piping or equipment, install pressure and temperature test plugs to seal systems.
   2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with Section 220716 "Plumbing Equipment Insulation" and Section 220719 "Plumbing Piping Insulation."

C. Mark equipment and balancing devices, including valve position indicators and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound IP units.

3.4 GENERAL PROCEDURES FOR PLUMBING EQUIPMENT

A. Test, adjust, and balance plumbing equipment indicated on Drawings, including, but not limited to, the following:
   1. Motors.
   2. Domestic water booster pumps.
   3. Domestic water in-line pumps.
   4. Domestic water heaters.

3.5 PROCEDURES FOR DOMESTIC WATER SYSTEMS

A. Prepare test reports for pumps and other equipment. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required equipment flow rates with system design flow rates.

B. Prepare schematic diagrams of systems' Record drawings piping layouts.

C. In addition to requirements in "Preparation" Article, prepare domestic water systems for testing and balancing as follows:
   1. Check expansion tank for proper setting.
   2. Check water heater for proper discharge temperature setting.
   3. Check remotest point of outlet for adequate pressure.
   4. Check flow-control valves for proper position.
   5. Locate start-stop and disconnect switches, electrical interlocks, and motor controllers.
   6. Verify that motor controllers are equipped with properly sized thermal protection.
   7. Check that air has been purged from the system.

D. Measure and record upstream and downstream pressure of each piece of equipment.

E. Measure and record upstream and downstream pressure of pressure-reducing valves.

F. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.

G. Check settings and operation of each safety valve. Record settings.

3.6 PROCEDURES FOR DOMESTIC WATER SYSTEM BOOSTER PUMPS

A. Adjust pumps to deliver total design flow.
   1. Measure total water flow.
      a. Position valves for full flow through coils.
      b. Measure flow by main flow meter, if installed.
      c. If main flow meter is not installed, determine flow by pump TDH or known equipment pressure drop.
   2. Measure pump TDH as follows:
      a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
      b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
      c. Convert pressure to head and correct for differences in gauge heights.
      d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
      e. With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved. If excessive throttling is required to achieve desired flow, recommend pump impellers be trimmed to reduce excess throttling.
   3. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.

B. Adjust flow-measuring devices installed in mains and branches to design water flows.
   1. Measure flow in main and branch pipes.
   2. Adjust main and branch balance valves for design flow.
   3. Re-measure each main and branch after all have been adjusted.

C. Verify final system conditions as follows:
   1. Re-measure and confirm that total water flow is within design.
   2. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
   3. Mark final settings.

D. Verify that memory stops have been set.

3.7 PROCEDURES FOR DOMESTIC HOT-WATER CIRCULATING INLINE PUMP

A. Balance system with manual or automatic balancing valves by setting at design flow.
   1. Measure flow in main and branch pipes.
   2. Adjust main and branch balance valves for design flow.
   3. Re-measure each main and branch after all have been adjusted.

B. Adjust pump to deliver total design flow.
   1. Measure pump TDH as follows:
      a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
      b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
      c. Convert pressure to head and correct for differences in gauge heights.

d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.

2. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.
3. Mark final settings and verify that all memory stops have been set.
4. Verify final system conditions as follows:
   a. Re-measure and confirm that total flow is within design.
   b. Re-measure final pumps' operating data, TDH, volts, amps, speed, and static profile.
   c. Mark final settings.

3.8 PROCEDURES FOR MOTORS

A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:
   1. Manufacturer's name, model number, and serial number.
   2. Motor horsepower rating.
   3. Motor rpm.
   4. Phase and hertz.
   5. Nameplate and measured voltage, each phase.
   6. Nameplate and measured amperage, each phase.
   7. Starter size and thermal-protection-element rating.
   8. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.9 PROCEDURES FOR WATER HEATERS

A. Electric Water Heaters:
   1. Measure and record entering- and leaving-water temperatures.
   2. Measure and record water flow.
   3. Measure and record pressure drop.
   4. Measure and Record relief valve(s) pressure setting.
   5. Capacity: Calculate in Btu/h of heating output.
   6. Efficiency: Calculate operating efficiency for comparison to submitted equipment.

3.10 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 flows, temperatures, and pressures of each piece of equipment. Compare the values to design or nameplate information, where information is available.
   2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
   3. Check the condition of filters.

4. Check bearings and other lubricated parts for proper lubrication.
5. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

B. TAB After Construction: Before performing testing and balancing of renovated existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished in accordance with renovation scope indicated by Contract Documents. Verify the following:
1. New filters are installed.
2. Bearings and other parts are properly lubricated.
3. 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 system flows of the renovated work to the measured flows, and determine the new pump speed.
2. Verify that the indicated system flows of the renovated work result in velocities and pump speeds that are within the acceptable limits defined by equipment manufacturer.
3. If calculations increase or decrease the system 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.

3.11 TOLERANCES

A. Set plumbing system's flow rates within the following tolerances:
1. Domestic Water Flow Rate: Plus or minus 5 percent. If design value is less than 10 gpm, within 10 percent.

3.12 PROGRESS 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 system-balancing devices. Recommend changes and additions to system-balancing devices, to facilitate proper performance measuring and balancing. Recommend changes and additions to plumbing systems and general construction to allow access for performance-measuring and -balancing devices.

B. Status Reports: Prepare monthly 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.

3.13 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:
1. Pump curves.
2. Manufacturers' test data.
3. Field test reports prepared by system and equipment installers.
4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.
2. Name and address of the TAB specialist.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents, including the following:
    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Notes to explain why certain final data in the body of reports vary from indicated values.
14. Test conditions for pump performance forms, including the following:
    a. Variable-frequency controller settings for variable-flow hydronic systems.
    b. Settings for pressure controller(s).
    c. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of distribution systems. Present each system with single-line diagram and include the following:
1. Flow rates.
2. Pipe and valve sizes and locations.
3. Balancing stations.
4. Position of balancing devices.

E. Electric Water Heater Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
1. Unit Data:
    a. System identification.
    b. Location.
    c. Model number and unit size.
    d. Manufacturer's serial number.

e. Output capacity in Btu/h.
f. Number of stages.
g. Connected volts, phase, and hertz.
h. Rated amperage.

2. Test Data (Indicated and Actual Values):
a. Heat output in Btu/h.
b. Entering-water temperature in deg F.
c. Leaving-water temperature in deg F.
d. High-temperature-limit setting in deg F.
e. Operating set point in deg F.
f. Voltage at each connection.
g. Amperage for each phase.

F. 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.
g. Water-pressure differential in feet of head or psig.
h. Required net positive suction head in feet of head or psig.
i. Pump speed.
j. Impeller diameter in inches.
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full-load amperage and service factor.
p. Seal type.
2. Test Data (Indicated and Actual Values):
a. Static head in feet of head or psig.
b. Pump shutoff pressure in feet of head or psig.
c. Actual impeller size in inches.
d. Full-open flow rate in gpm.
e. Full-open pressure in feet of head or psig.
f. Final discharge pressure in feet of head or psig.
g. Final suction pressure in feet of head or psig.
h. Final total pressure in feet of head or psig.
i. Final water flow rate in gpm.
j. Voltage at each connection.
k. Amperage for each phase.

G. Instrument Calibration Reports:
1. Report Data:
a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.

e. Dates of calibration.

3.14 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Commissioning Authority.

B. Commissioning Authority shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to the lesser of either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

C. 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."

D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the TAB shall be considered incomplete and shall be rejected.

E. If recheck measurements find the number of failed measurements noncompliant with requirements indicated, proceed as follows:
1. TAB specialists shall 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. All changes shall be tracked to show changes made to previous report.
2. If the second final inspection also fails, Owner may pursue other Contract options to complete TAB work.

F. Prepare test and inspection reports.

3.15 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.

END OF SECTION

SECTION 220719 – PLUMBING 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 plumbing piping services:

1. Domestic hot-water piping.
2. Domestic recirculating hot-water piping.
3. Roof drains and rainwater leaders.
4. Supplies and drains for disabled-accessible lavatories and sinks.

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 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.

C. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Supply and Drain Protective Shielding Guards: ICC A117.1.

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 sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing 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.

1.7 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 "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. Products: Subject to compliance with requirements, provide the following:
      a. Pittsburgh Corning Corporation; Foamglas.
   2. Block Insulation: ASTM C 552, Type I.
   3. Special-Shaped Insulation: ASTM C 552, Type III.
   4. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
   5. Preformed Pipe Insulation with Factory-Applied ASJ: 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. Products: Subject to compliance with requirements, provide one of the following:
      a. Johns Manville; Micro-Lok.
      b. Knauf Insulation; 1000-Degree Pipe Insulation.
      c. Manson Insulation Inc.; Alley-K.
   2. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, without factory-applied jacket. 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, provide one of the following:
      a. Ramco Insulation, 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 Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
      b. Eagle Bridges - Marathon Industries; 225.
   2. 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).
   3. 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. Products: Subject to compliance with requirements, provide one of the following:
      a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
      b. Vimasco Corporation; 749.
   2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
   3. Service Temperature Range: Minus 20 to plus 180 deg F.
   4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
   5. Color: White.

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. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
      b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
      c. Vimasco Corporation; 713 and 714.
   3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
   4. Service Temperature Range: 0 to plus 180 deg F.
   5. Color: White.

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.

2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.
   1. Products: Subject to compliance with requirements, provide the following:
      a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas Number 10.

2.8 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. ABI, Ideal Tape Division; 370 White PVC tape.
      b. Compac Corporation; 130.
      c. Venture Tape; 1506 CW NS.
   2. Width: 2 inches.
   3. Thickness: 6 mils.
   4. Adhesion: 64 ounces force/inch in width.
   5. Elongation: 500 percent.
   6. Tensile Strength: 18 lbf/inch in width.

2.9 SECUREMENTS

A. Bands:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. ITW Insulation Systems; Gerrard Strapping and Seals.
      b. RPR Products, Inc.; Insul-Mate Strapping and Seals.
   2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with closed seal.
   3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

C. Wire: 0.080-inch nickel-copper alloy.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. C & F Wire.

2.10 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. McGuire Manufacturing.

b. Plumberex.
c. Truebro; a brand of IPS Corporation.
d. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot-water supply and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Truebro; a brand of IPS Corporation.
b. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

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.

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 thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. 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 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- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
   3. Overlap jacket longitudinal seams at least 1-1/2 inches. 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 4 inches o.c.
a. For below-ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to 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 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. 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 below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
   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. 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.
   7. 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.

8. 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. 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.
3. 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 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.
4. 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 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 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.

C. 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.

3.7 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 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 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.

C. 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.

3.8 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 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.

3.9 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 Hot and Recirculated Hot Water:
   1. NPS 1-1/4 and Smaller: Insulation shall be one of the following:
      a. Mineral-Fiber, Preformed Pipe Insulation, Type I.

B. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
   1. All Pipe Sizes: Insulation shall be one of the following:
      a. Mineral-Fiber, Preformed Pipe Insulation, Type I.

END OF SECTION

SECTION 221116 – DOMESTIC 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, and fittings inside buildings.
2. Encasement for piping.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 FIELD 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 interrupt water service without Construction Manager's written permission.

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.

B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

B. Copper Unions:
1. MSS SP-123.
2. Cast-copper-alloy, hexagonal-stock body.
3. Ball-and-socket, metal-to-metal seating surfaces.
4. Solder-joint or threaded ends.

2.3 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105/A21.5.

B. Form: Sheet.

C. Color: Natural.

2.4 TRANSITION FITTINGS

A. General Requirements:
1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Cascade Waterworks Manufacturing.
b. Dresser, Inc.; Piping Specialties Products.
c. Ford Meter Box Company, Inc. (The).

2.5 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. Manufacturers: Subject to compliance with requirements, provide products by the following provide products by one of the following:
a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
b. Watts; a division of Watts Water Technologies, Inc.
c. Wilkins; a Zurn company.
2. Standard: ASSE 1079.
3. Pressure Rating: 125 psig minimum at 180 deg F.

4. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Nipples:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Elster Perfection Corporation.
   b. Grinnell Mechanical Products; Tyco Fire Products LP.
   c. Precision Plumbing Products, Inc.
   d. Victaulic Company.
2. Standard: IAPMO PS 66.
3. Electroplated steel nipple complying with ASTM F 1545.
4. Pressure Rating and Temperature: 300 psig at 225 deg F.
5. End Connections: Male threaded or grooved.
6. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Section 312000 "Earthwork" for excavating, trenching, and backfilling.

3.2 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/A21.5.

D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."

E. Install shutoff valve immediately upstream of each dielectric fitting.

F. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."

G. Install domestic water piping level without pitch and plumb.

H. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

I. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

J. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

K. 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.

L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

M. Install piping to permit valve servicing.

N. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

O. Install piping free of sags and bends.

P. Install fittings for changes in direction and branch connections.

Q. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

R. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping."

S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 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. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Soldered Joints for Copper Tubing: 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."

E. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:
   1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
   2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

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 and Smaller: Use dielectric couplings or nipples.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
   1. Vertical Piping: MSS Type 8 or 42, clamps.
   2. Individual, Straight, Horizontal Piping Runs:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
      c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
   3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
   2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
   3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.

F. Install supports for vertical copper tubing every 10 feet.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
   1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
   2. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
   3. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.8 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

B. Label pressure piping with system operating pressure.

3.9 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Piping Inspections:
      a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
      b. 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:

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 authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:
a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
b. 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.
c. 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.
d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.10 ADJUSTING

A. Perform the following adjustments before operation:
1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.

8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 CLEANING

A. Clean and disinfect potable domestic water piping as follows:
   1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
   2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
      a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
      b. Fill and isolate system according to either of the following:
         1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
         2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
      c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
      d. Repeat procedures if biological examination shows contamination.
      e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Clean non-potable domestic water piping as follows:
   1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
   2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
      a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
      b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.12 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. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:
   1. Hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and soldered joints.

3.1 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
   1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
   2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
   3. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
   4. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION

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. Vacuum breakers.
   2. Backflow preventers.
   3. Balancing valves.
   4. Strainers.
   5. Hose bibbs.
   6. Drain valves.
   7. Water hammer arresters.
   8. Trap-seal primer valves.

B. Related Sections include the following:
   1. Division 22 Section 220519 "Meters and Gages For Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. NSF Compliance:
   1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.

2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

A. Hose-Connection Vacuum Breakers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Woodford Manufacturing Company.
   b. Zurn Plumbing Products Group; Wilkins Div.
   c. Watts Industries, Inc.; Water Products Div.
   d. MIFAB, Inc.
2. Standard: ASSE 1011.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome or nickel plated.

2.2 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. FEBCO; SPX Valves & Controls.
   b. Watts Industries, Inc.; Water Products Div.
   c. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Body: Bronze for and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for and larger.
5. End Connections: Threaded.
6. Configuration: Designed for horizontal, straight through flow.
7. Accessories:
   a. Valves: Ball type with threaded ends on inlet and outlet of and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of and larger.
   b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

B. Hose-Connection Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Conbraco Industries, Inc.
   b. Watts Industries, Inc.; Water Products Div.
   c. Woodford Manufacturing Company.
2. Standard: ASSE 1052.
3. Operation: Up to back pressure.
4. Inlet Size:3/4".

5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
6. Capacity: At least flow.

2.3 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide a product by one of the following:
   a. Taco, Inc.
   b. Watts Industries, Inc.; Water Products Div.
   c. NIBCO INC.
4. Type: Ball valve with two readout ports and memory setting indicator.
5. Body: Bronze,
6. Size: Same as connected piping, but not larger than.
7. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

2.4 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Primary, Thermostatic, Water Mixing Valves MX-X:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Lawler Manufacturing Company, Inc.
   b. Leonard Valve Company.
   c. Symmons Industries, Inc.
   d. Or Equal.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Type: Cabinet-type, thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: 120 deg F.
9. Tempered-Water Design Flow Rate: See Plans.
10. Pressure Drop at Design Flow Rate: Varies.
11. Valve Finish: Chrome plated.
12. Piping Finish: Copper.

2.5 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:
1. Pressure Rating: minimum, unless otherwise indicated.

2. Body: Bronze for and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for and larger.
3. End Connections: Threaded and smaller; flanged for and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Drain: Factory-installed, hose-end drain valve.

2.6 HOSE BIBBS

A. Hose Bibbs HB-1:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Josam Company
   b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc,
   c. Zurn Plumbing Products Group; Light Commercial Operation
2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
3. Operation: Loose Key.
4. Outlet: Concealed, with integral vacuum breaker or nonremovable hose-connection vacuum breaker complying with ASSE 1011; and garden-hose thread complying with ASME B1.20.7.
5. Box: Deep, flush mounting with cover.
6. Box and Cover Finish: Chrome plated.
7. Outlet: Exposed, with integral vacuum breaker or nonremovable hose-connection vacuum breaker complying with ASSE 1011; and garden-hose thread complying with ASME B1.20.7
8. Nozzle and Wall-Plate Finish: Polished nickel bronze.
9. Operating Key(s): Two with each wall hydrant.

B. Hose Bibbs HB-2:
1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 3/4 (DN 20) threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig (860 kPa).
7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Rough bronze.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Operating key.
13. Operation for Finished Rooms: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.7 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:
1. Standard: MSS SP-110 for standard-port, two-piece ball valves.

2. Pressure Rating: minimum CWP.
3. Body: Copper alloy.
4. Ball: Chrome-plated brass.
5. Seats and Seals: Replaceable.
6. Handle: Vinyl-covered steel.
7. Inlet: Threaded or solder joint.
8. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.8 WATER HAMMER ARRESTERS

A. Water Hammer Arresters WH-A:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   b. PPP Inc.
   c. MIFAB, Inc.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.9 TRAP-SEAL PRIMER VALVES

A. Supply-Type (Single), Trap-Seal Primer Valves TP-1:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. MIFAB, Inc.
   b. PPP Inc.
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
2. Standard: ASSE 1018.
3. Pressure Rating: minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Supply-Type (Multiple), Trap-Seal Primer Valves TP-2:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. MIFAB, Inc.
   b. PPP Inc.
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
2. Standard: ASSE 1018.
3. Pressure Rating: minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: threaded or solder joint.

7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Revise remaining paragraphs and subparagraphs in this Article to include specific installation requirements.

B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
3. Do not install bypass piping around backflow preventers.

C. Install balancing valves in locations where they can easily be adjusted.

D. Install Y-pattern strainers for water on supply side of each solenoid valve, and pump.

E. Install water hammer arresters in water piping according to PDI-WH 201.

F. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

B. Ground equipment according to Division 26 Section 260526 "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Division 26 Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
1. Reduced-pressure-principle backflow preventers.
2. Double-check backflow-prevention assemblies.

3. Calibrated balancing valves.
4. Supply-type, trap-seal primer valves.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:
   1. Test each reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.5 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION

SECTION 221316 – SANITARY WASTE AND VENT 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, tube, and fittings.
   2. Specialty pipe fittings.
   3. Encasement for underground metal piping.

1.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
   1. Soil, Waste, and Vent Piping: 10-foot head of water.

B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For waste and vent piping, 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. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Sanitary Waste 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 at least two days in advance of proposed interruption of sanitary waste service.
   2. Do not proceed with interruption of sanitary waste service without Construction Manager's written permission.

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 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301. Marked with CISPI collective trademark.

B. CISPI, Hubless-Piping Couplings:
   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. ANACO-Husky.
      b. Fernco Inc.
      c. MIFAB, Inc.
      d. Mission Rubber Company; a division of MCP Industries, Inc.
      e. Tyler Pipe.
   2. Standards: ASTM C 1277 and CISPI 310.
   3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.3 COPPER TUBE AND FITTINGS

A. Copper Type DWV Tube: ASTM B306, drainage tube, drawn temper.

B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

C. Hard Copper Tube: ASTM B88, Type L and Type M (ASTM B88M, Type B and Type C), water tube, drawn temper.

D. Soft Copper Tube: ASTM B88, Type L (ASTM B88M, Type B), water tube, annealed temper.

E. Copper Pressure Fittings:

1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

F. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.

1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

G. Solder: ASTM B32, lead free with ASTM B813, water-flushable flux.

2.4 PVC PIPE AND FITTINGS

A. Comply with NSF 14 for plastic piping components. Include "NSF-dwv" marking for plastic drain, waste, and vent piping and "NSF-sewer" marking for plastic sewer piping.

B. Solid-Wall PVC Pipe: ASTM D2665 drain, waste, and vent.

C. PVC Socket Fittings: ASTM D2665, made in accordance with ASTM D3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

D. Adhesive Primer: ASTM F656.

E. Solvent Cement: ASTM D2564.

2.5 SPECIALTY PIPE FITTINGS

A. Transition Couplings:
1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
3. Unshielded, Nonpressure Transition Couplings:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Dallas Specialty & Mfg. Co.
      2) Fernco Inc.
      3) Mission Rubber Company; a division of MCP Industries, Inc.
      4) Plastic Oddities; a division of Diverse Corporate Technologies, Inc.

b. Standard: ASTM C 1173.
c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
d. 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.

4. Shielded, Nonpressure Transition Couplings:
a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1) Cascade Waterworks Mfg. Co.
2) Mission Rubber Company; a division of MCP Industries, Inc.
b. Standard: ASTM C 1460.
c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Dielectric Fittings:
1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
2. Dielectric Unions:
a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1) Capitol Manufacturing Company.
2) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
3) Wilkins; a Zurn company.
b. Description:
1) Standard: ASSE 1079.
2) Pressure Rating: 125 psig minimum at 180 deg F.
3) End Connections: Solder-joint copper alloy and threaded ferrous.
3. Dielectric Nipples:
a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1) Elster Perfection.
2) Precision Plumbing Products, Inc.
3) Victaulic Company.
b. Description:
1) Standard: IAPMO PS 66
2) Electroplated steel nipple.
3) Pressure Rating: 300 psig at 225 deg F.
4) End Connections: Male threaded or grooved.
5) Lining: Inert and noncorrosive, propylene.

2.6 ENCASEMENT FOR UNDERGROUND METAL PIPING

A. Standard: ASTM A 674 or AWWA C105/A 21.5.

B. Material: Linear low-density polyethylene film of 0.008-inch.

C. Form: Sheet.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earthwork."

3.2 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 coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

K. Make changes in direction for 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 two 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.

L. 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.

M. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 2 percent downward in direction of flow for piping NPS 4 and larger.
2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.

N. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.

O. Install aboveground copper tubing in accordance with CDA's "Copper Tube Handbook."

P. Install underground PVC piping in accordance with ASTM D2321.

Q. Plumbing Specialties:
1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
2. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Section 221319 "Drainage Piping Specialties."

R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

B. Join copper tube and fittings with soldered joints in accordance with ASTM B828. Use ASTM B813, water-flushable, lead-free flux and ASTM B32, lead-free-alloy solder.

C. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

D. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:

1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
2. PVC Piping: Join in accordance with ASTM D2855 and ASTM D2665 appendixes.

E. Joint Restraints and Sway Bracing:

1. Provide joint restraints and sway bracing for storm drainage piping joints to comply with the following conditions:
    a. Provide axial restraint for pipe and fittings 5 inches and larger, upstream, and downstream of all changes in direction, branches, and changes in diameter greater than two pipe sizes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:
1. Install transition couplings at joints of piping with small differences in OD's.
2. In Drainage Piping: Shielded, nonpressure transition couplings.
3. In Aboveground Force Main Piping: Fitting-type transition couplings.
4. In Underground Force Main Piping:
    a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
    b. NPS 2 and Larger: Pressure transition couplings.

B. Dielectric Fittings:
1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric nipples.

3.5 VALVE INSTALLATION

A. General valve installation requirements are specified in Section 220523.12 "Ball Valves for Plumbing Piping."

B. Backwater Valves: Install backwater valves in piping subject to backflow.
1. Horizontal Piping: Horizontal backwater valves.

2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
3. Install backwater valves in accessible locations.
4. Comply with requirements for backwater valve specified in Section 221319 "Sanitary Waste Piping Specialties."

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42, clamps.
6. Install individual, straight, horizontal piping runs:
   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Install hangers for cast-iron and copper soil piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

E. Support vertical runs of cast-iron and copper soil piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

F. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.

G. Support vertical piping and tubing at base and at each floor.

H. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

I. 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: 60 inches with 3/8-inch rod.

2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.

J. Install supports for vertical cast-iron soil piping every 15 feet.

K. According to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:
1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Install horizontal backwater valves with cleanout cover flush with floor.
6. Comply with requirements for cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
7. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Where installing piping adjacent to equipment allow space for service and maintenance of equipment.

E. Make connections according to the following unless otherwise indicated:
1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 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. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections, and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of 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. 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. 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.

3.10 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

D. Exposed Plastic Piping: Protect PVC plumbing vents exposed to sunlight with two coats of water-based latex paint.

E. Repair damage to adjacent materials caused by waste and vent piping installation.

3.11 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil and waste piping NPS 4 and smaller shall be any of the following:
1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
2. Copper Type DWV tube, copper drainage fittings, and soldered joints.
3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

C. Aboveground, vent piping NPS 4 and smaller shall be the following:
1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
2. Copper Type DWV tube, copper drainage fittings, and soldered joints.
3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

D. Underground, soil, waste, and vent piping NPS 4 and smaller shall be the following:

1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

E. Underground, soil and waste piping NPS 5 and larger are to be the following:

1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

END OF SECTION

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 plumbing specialties:
   1. Balancing valves.
   2. Water Filters.
   3. Cleanouts.
   4. Floor drains.
   5. Floor sinks.
   6. Drain Receptors.

1.3 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing piping systems with following minimum working-pressure ratings, unless otherwise indicated:
   1. Domestic Water Piping: 125 psig.
   2. Sanitary Waste and Vent Piping: 10-foot head of water.

1.4 SUBMITTALS

A. Product Data: Include rated capacities and shipping, installed, and operating weights. Indicate materials, finishes, dimensions, required clearances, and methods of assembly of components; and piping and wiring connections for the following:
   1. Balancing valves, water filters, and strainers.
   2. Thermostatic water mixing valves and water tempering valves.
   3. Water hammer arresters, air vents, and trap seal primer valves and systems.
   4. Drain valves, hose bibbs, hydrants, and hose stations.
   5. Sleeve penetration systems.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Field test reports.

D. Maintenance Data: For plumbing specialties to include in maintenance manuals. Include the following:
   1. Water filters.
   2. Thermostatic water mixing valves and water tempering valves.

3. Trap seal primer valves and systems.

1.5 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of plumbing specialties and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

B. Plumbing specialties 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. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for piping materials and installation.

E. NSF Compliance:
1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components. Include marking "NSF-pw" on plastic potable-water piping and "NSF-dwv" on plastic drain, waste, and vent piping.
2. Comply with NSF 61, "Drinking Water System Components--Health Effects, Sections 1 through 9," for potable domestic water plumbing specialties.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Water Filter Cartridges: Equal to 200 percent of amount installed for each type and size indicated.
2. Operating Key Handles: Equal to 100 percent of amount installed for each key-operated hose bibb and hydrant installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
1. Products: Subject to compliance with requirements, provide one of the products specified.
2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 BALANCING VALVES

A. Calibrated Balancing Valves: Adjustable, with two readout ports and memory setting indicator. Include manufacturer's standard hoses, fittings, valves, differential pressure meter, and carrying case.
   1. Manufacturers:
      a. Amtrol, Inc.
      b. Taco, Inc.
      c. Watts Industries, Inc.; Water Products Div.
   2. NPS 2 and Smaller: Bronze body with brass ball, adjustment knob, calibrated nameplate, and threaded or solder-joint ends.
   3. NPS 2 and Smaller: Bronze, Y-pattern body with adjustment knob and threaded ends.
   4. NPS 2-1/2 and Larger: Cast-iron, Y-pattern body with bronze disc and flanged or grooved ends.

2.3 WATER FILTERS

A. Manufacturers:
   1. Filtrine Manufacturing Company; Drinking Water Division.
   2. Osmonics.
   3. PURA, Inc.
   4. U.S. Filter; Filterite Div.
   5. Watts Industries, Inc.; Water Products Div.

B. General: Cartridge-type assemblies suitable for potable water. Include housing, fittings, filter cartridges, and cartridge end caps.

2.4 CLEANOUTS

A. Cleanouts, WCO: Comply with ASME A112.36.2M or ASME A112.3.1.
   1. Application: Wall cleanout.
   2. Products:
      a. Josam Co.
      b. Smith, Jay R. Mfg. Co.
      c. Zurn Industries, Inc., Specification Drainage Operation
   3. Body or Ferrule Material: Cast iron.
   4. Clamping Device: Required.
   5. Outlet Connection: Threaded.
   6. Closure: Brass plug with straight threads and gasket.
   7. Adjustable Housing Material: Cast iron with threads.
   8. Frame and Cover Material and Finish: Polished bronze.
   9. Frame and Cover Shape: Round.

2.5 FLOOR DRAINS

A. Floor Drains, FD-1: Comply with ASME A112.21.1M.
   1. Application: Shower drain.
   2. Products:

a. Josam Co.; Model 30000-Z-A.
b. Smith, Jay R. Mfg. Co.; Fig. 2005-A.
c. Zurn Industries, Inc., Specification Drainage Operation; Model Z-415.
3. Body Material: Gray iron.
4. Seepage Flange: Required.
5. Clamping Device: Required.
6. Outlet: Bottom.
7. Exposed Surfaces and Interior Lining: Not required.
8. Sediment Bucket: Not required.
9. Top or Strainer Material: Nickel bronze.
10. Top of Body and Strainer Finish: Chrome.
11. Top Shape: Round.
12. Dimensions of Top or Strainer: 5-inches diameter.
13. Top Loading Classification: Light Duty.
14. Trap Material: Cast iron.
15. Trap Pattern: Standard P-trap with trap primer connection.
16. Trap Features: Not required.

2.6 FLOOR SINKS

A. Floor Sinks, FS-1: Comply with ASME A12.21.1M.
1. Application: Floor Sink.
2. Products:
a. Josam Co.
b. Smith, Jay R. Mfg. Co.; Fig 3100.
c. Zurn Industries, Inc., Specification Drainage Operation; Model No. Z-1910.
3. Body Material: Gray iron.
4. Seepage Flange: Required.
5. Clamping Device: Required.
6. Outlet: Bottom.
7. Exposed Surfaces and Interior Lining: Acid-resistant enamel.
8. Sediment Bucket: Not required.
9. Top Material: Gray iron.
10. Top Shape: Square.
11. Dimensions of Top or Strainer: 8-1/2 inch square.
12. Top Loading Classification: Medium Duty.
13. Trap Material: Cast iron.
14. Trap Pattern: Standard P-trap.
15. Trap Features: Trap seal primer valve drain connection.

B. Drain Receptor, DR-1: Comply with ASME A112.21.2M.
1. Applications: Drain receptor.
2. Products:
a. Smith, Jay R. Mfg. Co.; Fig. 3970.
b. Or approved equal.
3. Body Material: Cast iron.
4. Dimensions of Body: 10 ½ inches diameter.
5. Combination Flashing Ring and Gravel Stop: Required.
6. Outlet: Bottom.

7. Solid Water Dam.
8. Extension Collars: Required.
9. Underdeck Clamp: Required.
10. Sump Receiver: Required.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 23 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.

B. Install expansion joints on vertical risers, stacks, and conductors if indicated.

C. 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. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
   2. Locate at each change in direction of piping greater than 45 degrees.
   3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
   4. Locate at base of each vertical soil and waste stack.

D. Install cleanout deck plates with top flush with finished floor, for floor cleanouts for piping below floors.

E. Install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall, for cleanouts located in concealed piping.

F. Install flashing flange and clamping device with each stack and cleanout passing through floors with waterproof membrane.

G. Install vent flashing sleeves on stacks passing through roof. Secure over stack flashing according to manufacturer's written instructions.

H. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
   1. Position floor drains for easy access and maintenance.
   2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
      a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
      b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
      c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
   3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.

4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

I. Fasten wall-hanging plumbing specialties securely to supports attached to building substrate if supports are specified and to building wall construction if no support is indicated.

J. Fasten recessed-type plumbing specialties to reinforcement built into walls.

K. Install wood-blocking reinforcement for wall-mounting and recessed-type plumbing specialties.

L. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

M. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipefittings.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Connect plumbing specialties to piping specified in other Division 22 Sections.

D. Ground equipment.

E. 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.

F. Connect plumbing specialties and devices that require power according to Division 26 Sections.

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each backflow preventer, thermostatic water mixing valve, and trap seal primer system.
1. Text: Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.
2. Refer to Division 23 Section "Identification for HVAC Piping and Equipment" for nameplates and signs.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled trap seal primer systems and their installation, including piping and electrical connections. Report results in writing.
   1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.5 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain trap seal primer systems. Refer to Division 1 Section "Closeout Procedures."

END OF SECTION

SECTION 221319.13 – SANITARY DRAINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Floor drains.
   2. Floor sinks.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene styrene.

B. FRP: Fiberglass-reinforced plastic.

C. HDPE: High-density polyethylene.

D. PE: Polyethylene.

E. PP: Polypropylene.

F. PVC: Polyvinyl chloride.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 DRAIN ASSEMBLIES

A. Sanitary drains shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic sanitary piping specialty components.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:
1. Standard: ASME A112.6.3.
2. Pattern: Floor drain.
3. Body Material: Gray iron.
4. Seepage Flange: Required.
5. Anchor Flange: Not required.
6. Clamping Device: Not required.
7. Outlet: Bottom.
8. Backwater Valve: Not required.
9. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant enamel.
10. Sediment Bucket: Not required.
11. Top or Strainer Material: Nickel bronze.
12. Top of Body and Strainer Finish: Nickel bronze .
13. Top Shape: Round.
14. Top Loading Classification: Medium Duty.
15. Funnel: Not required.
16. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
17. Trap Material: Cast iron .
18. Trap Pattern: Standard P-trap.

2.3 FLOOR SINKS

A. Cast-Iron Floor Sinks:
1. Standard: ASME A112.6.7.
2. Pattern: Floor drain.
3. Body Material: Cast iron.
4. Anchor Flange: Required, with seepage holes.
5. Clamping Device: Required.
6. Outlet: Bottom, no-hub connection.
7. Coating on Interior Surfaces: Acid-resistant enamel.
8. Sediment Bucket: Not required.
9. Internal Strainer: Dome.
10. Internal Strainer Material: Aluminum.
11. Top Grate Material: Nickel Bronze, loose.
12. Top of Body and Grate Finish: Nickel bronze.
13. Top Shape: Square.
14. Top Loading Classification: No traffic.
15. Funnel: Not required.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
   1. Position floor drains for easy access and maintenance.
   2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
   3. Set with grates depressed according to the following drainage area radii:
      a. Radius, 30 Inches (750 mm) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch (6.35-mm) total depression.
      b. Radius, 30 to 60 Inches (750 to 1500 mm): Equivalent to 1 percent slope.
      c. Radius, 60 Inches (1500 mm) or Larger: Equivalent to 1 percent slope, but not greater than 1-inch (25-mm) total depression.
   4. Install floor-drain flashing collar or flange, so no leakage occurs between drain and adjoining flooring.
      a. Maintain integrity of waterproof membranes where penetrated.
   5. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

B. Install open drain fittings with top of hub 1 inch above floor.

3.2 CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Comply with requirements in Section 221319 "Sanitary Waste Piping Specialties" for backwater valves, air admittance devices and miscellaneous sanitary drainage piping specialties.

C. Install piping adjacent to equipment to allow service and maintenance.

3.3 LABELING AND IDENTIFYING

A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 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

SECTION 221413 – FACILITY STORM 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, tube, and fittings.
   2. Specialty pipe fittings.
   3. Encasement for underground metal piping.

1.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
   1. Storm Drainage Piping: 10-foot head of water.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For storm drainage piping, accessories, and components, from manufacturer.

B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Video Recording: Video recording of below grade storm drain piping with annotated full size and 11x17 drawings. Recording shall include all new and existing piping inside building to point of connection on site or to street main piping.

1.7 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF/ANSI 14, "Plastics Piping System Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

1.8 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 Owner no fewer than two days in advance of proposed interruption of storm-drainage service.
   2. Do not proceed with interruption of storm-drainage service without Owner's written permission.

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 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Heavy-Duty, Hubless-Piping Couplings:
   1. Standards: ASTM C 1277 and ASTM C 1540.
   2. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.3 COPPER TUBE AND FITTINGS

A. Copper Type DWV Tube: ASTM B306, drainage tube, drawn temper.

B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

C. Hard Copper Tube: ASTM B88, Type L and Type M (ASTM B88M, Type B and Type C), water tube, drawn temper.

D. Soft Copper Tube: ASTM B88, Type L (ASTM B88M, Type B), water tube, annealed temper.

E. Copper Pressure Fittings:
   1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.

2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

F. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

G. Solder: ASTM B32, lead free with ASTM B813, water-flushable flux.

2.4 PVC PIPE AND FITTINGS

A. Comply with NSF 14 for plastic piping components. Include "NSF-dwv" marking for plastic drain, waste, and vent piping and "NSF-sewer" marking for plastic sewer piping.

B. Solid-Wall PVC Pipe: ASTM D2665 drain, waste, and vent.

C. PVC Socket Fittings: ASTM D2665, made in accordance with ASTM D3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

D. Adhesive Primer: ASTM F656.

E. Solvent Cement: ASTM D2564.

2.5 SPECIALTY PIPE FITTINGS

A. Transition Couplings:
1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified-piping-system fitting.
3. Shielded, Non pressure Transition Couplings:
   a. Standard: ASTM C 1460.
   b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Dielectric Fittings:

2.6 ENCASEMENT FOR UNDERGROUND METAL PIPING

A. Standard: ASTM A 674 or AWWA C105.

B. Material: High-density, cross laminated PE film of 0.004-inch (0.10-mm) or LLDPE film of 0.008-inch (0.20-mm) minimum thickness.

C. Form: Sheet or tube.

D. Color: Black.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earthwork."

3.2 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 from layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping at indicated slopes.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Install piping to allow application of insulation.

I. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

J. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

K. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

L. Install storm drainage piping at the following minimum slopes unless otherwise indicated:
   1. Building Storm Drain: 1 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
   2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.

M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
   1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

N. Install aboveground copper tubing in accordance with CDA's "Copper Tube Handbook."

O. Install underground PVC piping in accordance with ASTM D2321.

P. Plumbing Specialties:
   1. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping.

Q. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Hubless, Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

B. Join copper tube and fittings with soldered joints in accordance with ASTM B828. Use ASTM B813, water-flushable, lead-free flux and ASTM B32, lead-free-alloy solder.

C. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:
   1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
   2. PVC Piping: Join in accordance with ASTM D2855 and ASTM D2665 appendixes.

D. Joint Restraints and Sway Bracing:

1. Provide joint restraints and sway bracing for storm drainage piping joints to comply with the following conditions:
    a. Provide axial restraint for pipe and fittings 5 inches and larger, upstream and downstream of all changes in direction, branches, and changes in diameter greater than two pipe sizes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:
1. Install transition couplings at joints of piping with small differences in OD's.
2. In Drainage Piping: Shielded, nonpressure transition couplings.

B. Dielectric Fittings:
1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric nipples.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42, clamps.
6. 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.
7. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Install hangers for cast-iron and copper soil piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Support horizontal piping and tubing within 12 inches of each fitting, and coupling.

E. Support vertical piping and tubing at base and at each floor.

F. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.

G. 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: 60 inches with 3/8-inch (10-mm) rod.
   2. NPS 3: 60 inches with 1/2-inch rod.
   3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
   4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
   5. Spacing for 10-foot pipe lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

H. Install supports for vertical cast-iron soil piping every 15 feet.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.
   1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

3.7 IDENTIFICATION

A. Identify exposed storm drainage piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.8 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
   1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
   2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   3. Test Procedure: Test storm drainage piping, 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 until completion of inspection, water level must not drop. Inspect joints for leaks.
   4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
   5. Prepare reports for tests and required corrective action.

3.9 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.10 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground storm drainage piping NPS 6 (DN 150) and smaller shall be the following:
   1. Hubless, cast-iron soil pipe and fittings; heavy-duty, hubless-piping couplings; and coupled joints.

C. Underground storm drainage piping NPS 6 (DN 150) and smaller shall be any of the following:
   1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

END OF SECTION

SECTION 221423 – STORM DRAINAGE 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. Section Includes:
   1. Roof drains.
   2. Miscellaneous storm drainage piping specialties.
   3. Cleanouts.
   4. Through-penetration firestop assemblies.
   5. Flashing materials.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 METAL ROOF DRAINS

A. Cast-Iron, Large-Sump, General-Purpose Roof Drains RD-1:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Josam Company.
      b. Smith, Jay R. Mfg. Co.
      c. Zurn Industries, LLC.
      d. Or equal.
   2. Standard: ASME A112.6.4, for general-purpose roof drains.
   3. Body Material: Cast iron.
   4. Dimension of Body: Nominal 15-inch diameter.
   5. Flow-Control Weirs: Not required.
   6. Outlet: Bottom.
   7. Underdeck Clamp: Required.

8. Sump Receiver Plate: Required.
9. Dome Material: Cast iron.
10. Water Dam: Not required.

B. Cast-Iron, Large-Sump, General-Purpose Overflow Roof Drains ORD-1:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Josam Company.
   b. Smith, Jay R. Mfg. Co.
   c. Zurn Industries, LLC.
   d. Or equal.
2. Standard: ASME A112.6.4, for general-purpose roof drains.
3. Body Material: Cast iron.
4. Dimension of Body: Nominal 15-inch diameter.
5. Flow-Control Weirs: Not required.
6. Outlet: Bottom.
7. Underdeck Clamp: Required.
8. Sump Receiver Plate: Required.
9. Dome Material: Cast iron.
10. Water Dam: 2 inches (51 mm) high.

2.2 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Conductor Nozzles
1. Description: Bronze body with threaded inlet and bronze wall flange with mounting holes.
2. Size: Same as connected conductor.

2.3 CLEANOUTS

A. Floor Cleanouts:
1. Jay R Smith
2. Mifab
3. Josam
4. Zurn Industries.
5. Standard: ASME A112.36.2M, for threaded, adjustable housing cleanouts.
6. Size: Same as connected branch.
7. Type: Threaded, adjustable housing.
8. Body or Ferrule Material: Cast iron.
9. Clamping Device: Required.
10. Outlet Connection: Threaded.
11. Closure: Cast-iron plug.
12. Adjustable Housing Material: Cast iron with threads.
13. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
14. Frame and Cover Shape: Round.
15. Top-Loading Classification: Light Duty.
16. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

B. Test Tees:
   1. Standard: ASME A112.36.2M and ASTM A 74, ASTM A 888, or CISPI 301, for cleanout test tees.
   2. Size: Same as connected drainage piping.
   3. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or hubless, cast-iron soil-pipe test tee as required to match connected piping.
   4. Closure Plug: Countersunk or raised head, brass.
   5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

C. Wall Cleanouts WCO:
   1. Jay R Smith
   2. Mifab
   3. Josam
   4. Standard: ASME A112.36.2M, for cleanouts. Include wall access.
   5. Size: Same as connected drainage piping.
   6. Body Material: Hubless, cast-iron soil-pipe test tee as required to match connected piping.
   7. Closure: Countersunk or raised-head, cast-iron plug.
   8. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
   9. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
   10. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

2.4 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:
   1. Standard: ASTM E 814, for through-penetration firestop assemblies.
   2. Certification and Listing: Intertek Testing Service NA for through-penetration firestop assemblies.

2.5 FLASHING MATERIALS

A. Copper Sheet: ASTM B 152/B 152M,12 oz./sq. ft. (3.7 kg/sq. m or 0.41-mm thickness).

B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch (1.01-mm) minimum thickness unless otherwise indicated. Include G90 (Z275) hot-dip galvanized, mill-phosphatized finish for painting if indicated.

C. Elmdor Stoneman 6lb lead flashing.

D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil (1.01-mm) minimum thickness.

E. Fasteners: Metal compatible with material and substrate being fastened.

F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

G. Solder: ASTM B 32, lead-free alloy.

H. For additional requirements, see section 072600 Sheet Metal Fashing and Trim.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.
   1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
   2. Install expansion joints, if indicated, in roof drain outlets.
   3. Position roof drains for easy access and maintenance.

B. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.

C. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:
   1. Use cleanouts the same size 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 cleanouts at minimum intervals of 50 feet (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
   3. Locate cleanouts at base of each vertical soil and waste stack.

D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

F. Install test tees in vertical conductors and near floor.

G. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.

H. Install through-penetration firestop assemblies in plastic conductors at concrete floor penetrations.

I. Install sleeve flashing device with each conductor passing through floors with waterproof membrane.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 221413 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
   1. Lead Sheets: Burn joints of 6.0-lb/sq. ft. (30-kg/sq. m) lead sheets, 0.0938-inch (2.4-mm) thickness or thicker. Solder joints of 4.0-lb/sq. ft. (20-kg/sq. m) lead sheets, 0.0625-inch (1.6-mm) thickness or thinner.
   2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
   1. Pipe Flashing: Sleeve type, matching the pipe size, with a minimum length of 10 inches (250 mm) and with skirt or flange extending at least 8 inches (200 mm) around pipe.
   2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.
   3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 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

SECTION 223300 – ELECTRIC, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Heat pump water heater.
2. Domestic-water heater accessories.

1.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Domestic-water heaters shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.3 ACTION SUBMITTALS

A. Product Data: For each type and size of domestic-water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For domestic-water heaters, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Sustainable Design Submittals: Submit the necessary documentation to verify compliance with requirements specified in Division 01 Section “Sustainable Design Requirements.”

C. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

D. Source quality-control reports.

E. Field quality-control reports.

F. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For electric, domestic-water heaters to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects."

1.7 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures including storage tank and supports.
   b. Faulty operation of controls.
   c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Periods: From date of Substantial Completion.
   a. Electric, Storage, Domestic-Water Heaters:

1) Storage Tank: 3 years.
2) Controls and Other Components: Three years.

b. Compression Tanks: 1 year.

3. Warranty Periods: From date of Substantial Completion.
   a. Heat pump water heater:
      1) Controls and Other Components: Two years.
   b. Compression Tanks: 1 year.

4. Warranty Periods: From date of Substantial Completion.
   a. Storage tank: Five years.

PART 2 - PRODUCTS

2.1 COMMERCIAL ELECTRIC HEAT PUMP, DOMESTIC-WATER HEATERS

A. Heat Pump-Water Heaters:

1. Manufacturers: Nyle is the basis of design. Subject to compliance with requirements, provide products by one of the following:

   a. Nyle.
   b. Colmac.
   c. Lochinvar.
   d. Or equal.

2. Heat Pump Unit:

   a. Heat pump water heater shall be packaged air source equipment, factory assembled, charged, and tested. The heat pump shall be suitable for heating potable water and have the capability of producing no less than 160°F potable water, with published heating capacity and C.O.P. based on project specifications.
   b. Heat pump unit shall consist of compressor, condenser, evaporator coil, direct drive axial fan or a Centrifugal Blower, hot water circulation pump, piping, and controls, factory assembled, charged, and tested.
   c. All components, including assemblies, subassemblies and the materials that go into constructing the heat pump water heater's potable water system must be certified for coming in direct contact with potable water, including but not limited to: piping, brazing, soldering or welding materials, circulator pump, flow sensor, temperature sensors, thread sealant, flow control valves and flat plate heat exchanger.
   d. Entire heat pump shall be UL1995.
   e. Electrical: Unit control panel shall be UL1995.

3. Cabinet:

   a. Shall be corrosion resistant epoxy coated 12-gauge aluminum. Supports, channels and beams shall also be constructed of the like. Compartments

shall have large access doors for servicing. Refrigerant components shall be in a separate compartment from fan for in-operation servicing. Unit shall have stainless steel drip pan for condensate. Cabinet shall be designed for outdoor operation. Cabinet shall be insulated to prevent condensation from forming on exterior surfaces.

4. Compressor:

   a. Compressor: Hermetic scroll type by Copeland Corp., or reciprocating piston type by Carlyle Compressor suitable for high temperature operation with R-513a refrigerant. Compressor shall be furnished with service ports for suction and discharge connections.

   b. Compressor Controls: Compressor controls/accessories must include the following:

      1) High Pressure Safety monitoring.
      2) Low Pressure Safety monitoring.
      3) Multi-function Phase Failure Relay (scroll types).
      4) Active compressor mounted protection with advanced algorithms, fault history, and LED indicators. (scroll types).

5. Condenser:

   a. 316L Stainless steel copper brazed plate vented double wall type, standard on all units. Single wall condenser construction shall not be allowed. UL Listed, NSF 61 OR 372 compliant, and suitable for up to 450°F (232°C) high temperature operation with potable water. Unit shall be operational pressure rated to no less than 435 PSI (30 Bar), with built in temperature ports for performance monitoring. Refrigerant shall be 513a.

   b. Refrigerant Accessories:
      1) Filter-Drier: Sweat connection type.
      2) Site Glass: Moisture indicating type.
      3) Liquid Line Service Valves: Bronze quarter turn type.
      4) Discharge Check Valve: Copper magnetic in-line type.
      5) Liquid Line Solenoid Valve: Electrically actuated.
      6) Compressor Crankcase Heater: Belly ban type for scroll compressors.
      7) Suction accumulator.
      8) Liquid receiver.

6. Fan:

   a. Blower type fan shall be provided with capability of ducted discharge. Unit orientation shall be horizontal discharge to accommodate stacking of up to two units. (Field provided framework).

7. Evaporator Coil:

   a. Shall be copper tube with aluminum fins with E-Coating for corrosion protection.

b. Condensation shall be captured and drained to a single point connection with standard pipe threads.

8. Expansion Valve:

a. Thermal expansion valve shall be specifically designed for heat pump use with field adjustable superheat feature.

9. Anit-Short Cycle Control:

a. Anti-Short Cycle Control: Unites shall be factory wired to allow a maximum of twelve compressor starts per hour to prevent compressor short cycling and allow time for suction and discharge pressure to equalize permitting the compressor to start in an unloaded condition.

10. Water Circulating Pumps:

a. Shall be in-line stainless steel body NSF-61 Certified, centrifugal type able to deliver rated flow against the external head shown on the drawings.

11. Controls:

a. PLC Controls included for all heat pumps.
b. Times short cycle control.
c. Panel mount control touch screen.
d. Access level control.
e. Internal or external aquastat controls.
f. Resettable compressor run times.
g. Low temperature freeze/flow monitoring.
h. Flow rate meter for potable water.
i. Phase failure monitoring (scroll type compressors).
j. 100 fault memory.
k. Systems performance monitoring.
l. BMS compatibility with varied protocol options.
m. Bacnet MSTP.
n. Bacnet Ethernet.
o. Modbus MSTP.
p. Units shall be field configurable to be either master or slave identifiable, capable of being arranged in arrays. Communications between units shall be inherent ethernet. Units shall have built in lead lag compatibility. PLC shall monitor and control automated active and passive defrost, and wetted component freeze protection.
q. At each building, a master controller shall be provided for unit sequencing.
r. No ongoing licensing or subscription fees shall be required.

12. Constant Leaving Water Temperature Control (Single-Pass Only):

a. Constant leaving water temperature control (single-pass only): Heat pump shall be factory equipped with electronic temperature control valve which automatically maintains constant leaving water temperature regardless of entering water temperature. Leaving water temperature is set by the heat

pump operator/user via the field adjustable touch screen interface, freeze protection.

13. Cold Weather Package – For Operating down to 35°F:

    a. Frost prevention: Heat pump shall be factory equipped with electric resistive heating elements embedded into the entering air side of the evaporator coil(s). These heating elements will turn on when the evaporator temperature is below the Cut-In temperature (field adjustable setpoints).
    b. Condenser freeze protection: Heat pump shall be factory equipped with electric resistive heat trace over the evaporator but under the condenser insulation layer. This heat trace will turn on when the supply water temperature is below 34°F and terminate when supply water temperature is above 38°F.

14. Swing Tank:

    a. The water heaters(s) shall be TermaCharge as manufactured by Nyle Water Heating Systems or an approved equal. Heater(s) shall be rated at 12 kW, 480 volts, 3 phase, 60 cycle AC, and listed by Underwriters' Laboratories. Models shall meet the standby loss requirements of the U.S. Department of energy and current edition of ASHRAE/IES 90.1. Tank(s) shall be 119-gallon capacity. Heater(s) shall have 150 psi working pressure and be equipped with extruded high density anode rod. Tanks shall have the following water connections: 2" NPT hot water outlet (top), 2" NPT recirculation (side), and 2" inlet (side). Tank shall have three aquastat mounting positions on side. All internal surfaces of the heater(s) exposed to water shall be glass lined with an alkaline borosilicate composition that has been fused-to-steel by firing at a temperature range of 1400°F to 1600°F. Electric heating elements shall be medium watt density with zinc plated copper sheath. Each element shall be controlled by an individually mounted thermostat and high temperature cutoff switch. The outer jacket shall be of backed enamel finish and shall enclose the tank with foam insulation. Electrical junction box with heavy duty terminal block shall be provided. The drain valve shall be located in the front for ease of servicing. Heater tank shall have a three-year limited warranty as outlined in the written warranty.

2.2 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Compression Tanks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. AMTOL, Inc.
    b. Flexcon Industries.
    c. Honeywell Water Controls.
    d. Pentair Pump Group.
    e. Smith, A. O. Corporation.
    f. State Industries.
    g. TACO Comfort Solutions, Inc.

h. Or equal.

2. Description: Steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.

3. Construction:
   a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
   b. Interior Finish: Comply with NSF 61 Annex G barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
   c. Air-Charging Valve: Factory installed.

B. Drain Pans: Corrosion-resistant stainless steel with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.

C. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.

D. Heat-Trap Fittings: ASHRAE 90.2.

E. Manifold Kits: Domestic-water heater manufacturer's factory-fabricated inlet and outlet piping for field installation, for multiple domestic-water heater installation. Include ball-, butterfly-, or gate-type shutoff valves to isolate each domestic-water heater and calibrated balancing valves to provide balanced flow through each domestic-water heater.

1. Comply with requirements for ball-, butterfly-, or gate-type shutoff valves specified in Section 220523 "Ball Valves for Plumbing Piping".
2. Comply with requirements for balancing valves specified in Section 221119 "Domestic Water Piping Specialties."

F. Pressure-Reducing Valves: ASSE 1003 for water. Set at 25-psig- maximum outlet pressure unless otherwise indicated.

G. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.

H. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than domestic-water heater working-pressure rating.

I. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.

J. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.

K. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Include dimension

that will support bottom of domestic-water heater a minimum of 18 inches above the floor.

L. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

2.3 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test domestic-water heaters to minimum of one and one-half times pressure rating before shipment.

C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

A. Electric, Domestic-Water Heater Mounting: Install residential, electric, domestic-water heaters on floor.

1. Maintain manufacturer's recommended clearances.
2. Arrange units so controls and devices that require servicing are accessible.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Anchor domestic-water heaters to substrate.

B. Install electric, domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523 "Valves for Plumbing Piping".

C. Install electric, domestic-water heaters with seismic-restraint devices. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

D. 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.

E. Install combination temperature-and-pressure relief valves in water piping for electric, domestic-water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

F. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."

G. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."

H. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.

I. Fill electric, domestic-water heaters with water.

J. Charge domestic-water compression tanks with air.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform 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 operation.

3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

C. Prepare test and inspection reports.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train University's maintenance personnel to adjust, operate, and maintain electric, domestic-water heaters.

END OF SECTION

SECTION 224213.13 – COMMERCIAL WATER CLOSETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings 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. Water closets.
2. Flushometer valves.
3. Toilet seats.
4. Supports.

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 for water closets.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flushometer valves to include in operation and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.

1. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than one of each type.

1.6 PLUMBING FIXTURES

A. Plumbing fixtures and accessories provided in a toilet room or bathing room required to comply with CBC Section 11B-213.2 shall comply with CBC Sections 11B-213.3.

B. Accessible plumbing fixtures shall comply with all the requirements in CBC Division 6.

C. Heights and location of all accessible fixtures shall be mounted according to CBC Section 11B-602 through 11B-612.

D. Accessible fixture controls shall comply with CBC Sections 11B-602.3 for drinking fountains, 11B-604.6 for water closets, 11B-604.9.5 for children's water closets.

E. Effective March 1, 2017, all single-user toilet facilities shall be identified as Gender Neutral facilities by a door symbol that complies with CBC Sections 11B-216.8 and 11B-703.7.2.6.3. No pictogram, text or braille is required on the symbol. If tactile jamb signage is provided, the signage shall comply with the appropriate technical requirements of CBC Section 11B-703. Examples of appropriate designations are "ALL-GENDER RESTROOM", "RESTROOM" or "UNISEX RESTROOM". DSA BU 17-01.

F. Clearance around accessible water closets and in toilet compartments shall be 60 inches minimum measured perpendicular from the side wall and 56 inches minimum measured perpendicular from the rear wall per CBC Section 11B-604.3.1.

PART 2 - PRODUCTS

2.1 WALL-MOUNTED WATER CLOSETS

A. Water Closets - Wall Mounted, Back Spud:

1. Water Closets - Wall Mounted, Bottom Outlet, Top Spud: WC-1 & WC-2 (Accessible).

2. Source Limitations: Obtain water closets from single source from single manufacturer.

3. Bowl:

   a. Material: Vitreous china.
   b. Type: Siphon jet.
   c. Style: Flushometer valve.
   d. Mounting Height: ADA compliant.
   e. Rim Contour: Elongated.
   f. Water Consumption: Dual flush 1.1 gal. per flush.
   g. Spud Size and Location: NPS 1-1/2 (DN 40); back.
   h. Color: White.

4. Flushometer Valve:
5. Toilet Seat: WC-1 & WC-2
6. Support: Water-closet carrier.

2.2 FLUSHOMETER VALVES

A. Lever Handle, Diaphragm Flushometer Valves WC-1 & WC-2:

1. Delany Products.
2. Sloan Valve Company.
3. Zurn Industries, LLC.
4. Or equal.
5. Standard: ASSE 1037.
6. Minimum Pressure Rating: 125 psig.
7. Features: Include integral check stop and backflow-prevention device.
8. Material: Brass body with corrosion-resistant components.
9. Exposed Flushometer-Valve Finish: Chrome plated.
10. Panel Finish: Chrome plated or stainless steel.
11. Style: Exposed.
12. Consumption: 1.28 gal. per flush.
13. Minimum Inlet: NPS 1.
14. Minimum Outlet: NPS 1-1/4.

2.3 TOILET SEATS

A. Toilet Seats WC-1 & WC-2:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Bemis Manufacturing Company.
   b. Church Seats; Bemis Manufacturing Company.
   c. Olsonite Seat Co.
   d. Or equal.
2. Standard: IAPMO/ANSI Z124.5.
3. Material: Plastic.
4. Type: Commercial (Heavy duty).
5. Shape: Elongated rim, open front.
6. Hinge: Check.
7. Hinge Material: Noncorroding metal.
8. Seat Cover: Not required.
9. Color: White.

2.4 SUPPORTS

A. Water-Closet Carrier:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. JR Smith.
   b. Zurn Ind.
   c. Josam Co.

d. Or equal.

2. Source Limitations: Obtain water-closet carrier from single source from single manufacturer.

3. Description: Waste-fitting assembly, as required to match drainage piping material and arrangement with faceplates, couplings gaskets, and feet; bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

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 water-closet installation.

B. Examine walls and floors for suitable conditions where water closets will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Water-Closet Installation:

1. Install level and plumb according to roughing-in drawings.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
3. Install accessible, water closets at mounting height for the physically disabled, complying with ADA-ABA Accessibility Guidelines and CBC.

B. Support Installation:

1. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
2. Use carrier supports with waste-fitting assembly and seal.
3. Install floor-mounted, back-outlet water closets attached to building floor substrate, onto waste-fitting seals; and attach to support.

C. Flushometer-Valve Installation:

1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
4. Install actuators in locations that are easy for people with disabilities to reach.

D. Install toilet seats on water closets.

E. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

F. Joint Sealing:

1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.4 ADJUSTING

A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.

B. Adjust water pressure at flushometer valves to produce proper flow.

3.5 CLEANING AND PROTECTION

A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed water closets and fittings.

C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 224216.13 – COMMERCIAL LAVATORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings 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. Lavatories.
   2. Faucets.
   3. Supports.

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 for lavatories.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: Include diagrams for power, signal, and control wiring of automatic faucets.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.
   1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
      a. Servicing and adjustments of automatic faucets.

1.6 PLUMBING FIXTURES

A. Plumbing fixtures and accessories provided in a toilet room or bathing room required to comply with CBC Section 11B-213.2 shall comply with CBC Sections 11B-213.3.

B. Accessible plumbing fixtures shall comply with all of the requirements of 2022 CBC Division 6.

C. Heights and location of all fixtures shall be according to 2022 CBC Sections 11B-602 through 11B-612.

D. Fixture controls shall comply with 2022 CBC Sections, 11B-605.4 for urinals, 11B-606.4 for lavatories and sinks.

E. Accessible lavatories and sinks shall be mounted with the front of the higher of the rim or counter surface 34" maximum above the finish floor or ground. Depth of lavatories or sinks shall not interfere with knee and toe clearance provided in accordance with CBC Section 11B-306 when a forward approach is required. CBC Sections 11B-606.3 and 11B-606.

F. Water supply and drain pipes under lavatories and sinks shall be insulated or otherwise configured to protect against contact. There shall be no sharp or abrasive surfaces under lavatories and sinks. CBC Section 11B-606.5.

G. Effective March 1, 2017, all single-user toilet facilities shall be identified as Gender Neutral facilities by a door symbol that complies with CBC Sections 11B-216.8 and 11B-703.7.2.6.3. No pictogram, text or braille is required on the symbol. If tactile jamb signage is provided, the signage shall comply with the appropriate technical requirements of CBC Section 11B-703. Examples of appropriate designations are "ALL-GENDER RESTROOM", "RESTROOM" or "UNISEX RESTROOM". DSA BU 17-01.

PART 2 - PRODUCTS

2.1 VITREOUS-CHINA, UNDERCOUNTER-MOUNTED LAVATORIES

A. Lavatory - Rectangular, Vitreous China, Undercounter Mounted L-1:
   1. Fixture:
      a. Standard: ASME A112.19.2/CSA B45.1.
      b. Type: Undercounter mounting.
      c. Nominal Size: Rectangular, 21 by 19 inches.
      d. Faucet-Hole Punching: Three holes, 2-inch centers.
      e. Faucet-Hole Location: Top.
      f. Color: White.
      g. Mounting Material: Sealant.

   2. Faucet: L-1.

2.2 SOLID-BRASS, MANUALLY OPERATED FAUCETS

A. Low Lead Standards: Comply with NSF/ANSI 61 Annex G, NSF 372, and California Assembly Bill AB1953 for faucet materials that will be in contact with potable water.

B. Lavatory Faucets L-1: Metering-type, single-control mixing, commercial, solid-brass valve.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Bradley Corporation.
   b. Chicago Faucets; Geberit Company.
   c. Moen Incorporated.
   d. Or equal.
2. Standard: ASME A112.18.1/CSA B125.1.
3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punching's; coordinate outlet with spout and fixture receptor.
4. Body Type: Single hole.
5. Body Material: Commercial, solid brass.
6. Finish: Polished chrome plate.
7. Maximum Flow Rate: 1.0 gpm.
8. Mounting Type: Deck, concealed.
9. Valve Handle(s): Push button.
10. Spout: Rigid type.
11. Spout Outlet: Aerator.
12. Operation: Compression, manual.
13. Drain: Grid.

2.3 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.

D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type, or compression valve with inlet connection matching supply piping.

E. Operation: Loose key.

F. Risers:
   1. NPS 1/2 (DN 15).
   2. Chrome-plated, soft-copper flexible tube riser.

2.4 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/4 (DN 32) offset and straight tailpiece.

C. Trap:
   1. Size: NPS 1-1/2 by NPS 1-1/4 (DN 40 by DN 32).

2. Material: Chrome-plated, two-piece, cast-brass trap, and swivel elbow with 0.032-inch- (0.83-mm-) thick brass tube to wall; and chrome-plated, brass or steel wall flange.

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 lavatory installation.

B. Examine counters and walls for suitable conditions where lavatories will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install lavatories level and plumb according to roughing-in drawings.

B. Install supports, affixed to building substrate, for wall-mounted lavatories.

C. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

D. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

E. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

A. After completing installation of lavatories, inspect and repair damaged finishes.

B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed lavatories and fittings.

D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 224216.16 – COMMERCIAL SINKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings 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. Service sinks.
   2. Kitchen sinks.
   3. Manually operated sink faucets.
   4. Supply fittings.
   5. Waste fittings.
   6. Disposers.

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 for sinks.
   2. Include rated capacities, operating characteristics, and furnished specialties and accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted sinks.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sinks and faucets to include in operation and maintenance manuals.
   1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
      a. Servicing and adjustments for automatic faucets.

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. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.

1.7 PLUMBING FIXTURES

A. Accessible plumbing fixtures shall comply with all the requirements in CBC Division 6.

B. Heights and location of all accessible fixtures shall be mounted according to CBC Chapter 11B, Section 11B-602 through 11B-612.

C. Accessible fixture controls shall comply with CBC Sections 11B-606.4 for lavatories and sinks.

D. Accessible lavatories and sinks shall be mounted with the front of the higher of the rim or counter surface 34" maximum above the finish floor or ground. Depth of lavatories or sinks shall not interfere with knee and toe clearance provided in accordance with CBC Section 11B-306 when a forward approach is required. CBC Sections 11B-606.3 and 11B-606.7.

E. Water supply and drainpipes under accessible lavatories and sinks shall be insulated or otherwise configured to protect against contact. There shall be no sharp or abrasive surfaces under accessible lavatories and sinks. CBC Section 11B-606.5.

PART 2 - PRODUCTS

2.1 SERVICE SINKS

A. Service Sinks - Enameled Cast Iron, Floor Mounted: JS-1.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
a. American Standard.
b. Kohler.
2. Source Limitations: Obtain sinks from single source from single manufacturer.
3. Fixture:
a. Standard: ASME A112.19.1/CSA B45.2.
b. Style: With front apron and raised back.
c. Nominal Size: 28 by 28 inches.
d. Color: White.
e. Drain: Grid with NPS 3 outlet.
f. Rim Guard: Coated wire.
4. Faucet: JS-1.

2.2 KITCHEN SINKS

A. Kitchen Sinks - Stainless Steel, Counter Mounted (Accessible): S-1.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
a. Just.

b. Elkay.
2. Source Limitations: Obtain sinks from single source from single manufacturer.
3. Fixture:
   a. Standard: ASME A112.19.3/CSA B45.4.
   b. Type: Stainless steel, self-rimming, sound-deadened unit with ledge back.
   c. Number of Compartments: One.
   d. Overall Dimensions: 21" by 18".
   e. Material: 18 gauge, Type 304 stainless steel.
   f. Compartment:
      1) Drain: Grid with NPS 1-1/2 tailpiece.
      2) Drain Location: Near back of compartment.
      3) Depth: Wheelchair accessible.
4. Faucet(s): S-1.
   a. Number Required: One.
   b. Mounting: On ledge.
5. Supply Fittings:
   a. Standard: ASME A112.18.1/CSA B125.1.
   b. Supplies: Chrome-plated brass compression stop with inlet connection matching water-supply piping type and size.
      1) Operation: Loose key.
      2) Risers: NPS 1/2, ASME A112.18.6/CSA B125.6, braided or corrugated stainless steel flexible hose.
6. Waste Fittings:
   a. Standard: ASME A112.18.2/CSA B125.2.
   b. Trap(s):
      1) Size: NPS 2.
      2) Material:
         a) Chrome-plated, two-piece, cast-brass trap and swivel elbow with 17-gauge brass tube to wall; and chrome-plated brass or steel wall flange.
         b) Stainless steel, two-piece trap and swivel elbow with 0.012-inch-thick stainless steel tube to wall; and stainless steel wall flange.
7. Mounting: On counter with sealant.
8. Disposer: GD-1.

2.3 MANUALLY OPERATED SINK FAUCETS

A. Sink faucets intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

B. Commercial Sink Faucets - Manual Type: Single-control mixing, S-1.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Elkay.
      b. Just Manufacturing.
      c. Chicago.

2. Source Limitations: Obtain sink faucets from single source from single manufacturer.
3. Standard: ASME A112.18.1/CSA B125.1.
4. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
5. Body Type: Single hole.
6. Body Material: Commercial, solid brass, or die-cast housing with brazed copper and brass waterway.
7. Finish: Polished chrome plate.
8. Maximum Flow Rate: 1.0 gpm.
9. Mounting Type: Deck, exposed.
10. Valve Handle(s): Lever.
11. Spout Type: Swing.
12. Spout Outlet: Aerator.

C. Commercial Service Sink Faucets - Manual Type: JS-1.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Speakman Company.
   b. Chicago.
   c. T&S Brass and Bronze Works, Inc.
2. Source Limitations: Obtain sink faucets from single source from single manufacturer.
3. Description: Wall/back mounted, brass body, with integral service stops, checks, spout with bucket/pail hook, 3/4-inch (20-mm) hose thread end, integral vacuum breaker, inlets 8 inches (200 mm) o.c. and two-handle mixing.
4. Faucet:
   a. Standards:
      1) ASME A112.18.1/CSA B125.1.
      2) NSF 61 and NSF 372.
      3) ICC A117.1.
      4) ASSE 1001 (VB).
   b. Finish: Rough chrome plated.
   c. Handles: 4-inch wrist blade.
   d. Brace: Adjustable top brace.

2.4 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless steel wall flange.

D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Loose key.

F. Risers:
1. NPS 1/2.
2. Chrome-plated, soft-copper flexible tube.

2.5 WASTE FITTINGS

A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/2 offset and straight tailpiece.

C. Trap:
1. Size: NPS 1-1/2.
2. Material:
a. Chrome-plated, two-piece, cast-brass trap and swivel elbow with 17-gauge brass tube to wall; and chrome-plated brass or steel wall flange.

2.6 DISPOSERS

A. Continuous-Feed Disposers GD-1:
1. InSinkErator.

B. Standards: ASSE 1008 and UL 430, and listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. General: Include reset button; wall switch; corrosion-resistant chamber with jam-resistant, cutlery- or stainless steel grinder or shredder; NPS 1-1/2 (DN 40) outlet; quick-mounting, stainless steel sink flange; antisplash guard; and combination cover/stopper.

D. Model: Sound-insulated chamber.

E. Motor: 115 V ac, 1725 rpm, 3/4 hp with overload protection.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water-supply piping and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.

B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install sinks level and plumb in accordance with rough-in drawings.

B. Install supports, affixed to building substrate, for wall-hung sinks.

C. Install water-supply piping with stop on each supply to each sink faucet.
   1. Exception: Use ball valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping"
   2. Install stops in locations where they can be easily reached for operation.

D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

E. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 PIPING CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.

3.5 CLEANING AND PROTECTION

A. After completing installation of sinks, inspect and repair damaged finishes.

B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed sinks and fittings.

D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 224223 – COMMERCIAL SHOWERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings 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. Shower faucets.

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 for showers and basins.
   2. Include rated capacities, operating characteristics, and furnished specialties and accessories.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For shower faucets to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 SHOWER FAUCETS

A. NSF Standard: Comply with NSF 61 Annex G, NDF 372, and California Assembly Bill AB1953, for shower materials that will be in contact with potable water.

B. Shower Faucets SH-1:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Chicago Faucets; Geberit Company.
      b. Moen Incorporated.
      c. Symmons Industries, Inc.
      d. Or equal.
   2. Description: Single-handle, pressure-balance mixing valve with hot- and cold-water indicators; check stops; and shower head.
   3. Faucet:
      a. Standards: ASME A112.18.1/CSA B125.1 and ASSE 1016.

b. Body Material: Solid brass.
c. Finish: Polished chrome plate.
d. Maximum Flow Rate: 1.5 gpm unless otherwise indicated.
e. Mounting: Concealed.
f. Operation: Single-handle, twist or rotate control.
g. Antiscald Device: Integral with mixing valve.
h. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.

4. Supply Connections: NPS 1/2.
5. Shower Head:
   a. Standard: ASME A112.18.1/CSA B125.1.
   b. Type: Ball joint with arm and flange.
   c. Shower Head Material: Metallic with chrome-plated finish.
   d. Spray Pattern: Adjustable.
   e. Integral Volume Control: Not required.
   f. Shower-Arm, Flow-Control Fitting: Not required.
   g. Temperature Indicator: Not required.

C. Shower Faucets, Accessible, SH-2:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Chicago Faucets; Geberit Company.
   b. Moen Incorporated.
   c. Symmons Industries, Inc.
2. Description: Single-handle, thermostatic mixing valve with hot- and cold-water indicators; check stops; and shower head.
3. Faucet:
   a. Standards: ASME A112.18.1/CSA B125.1 and ASSE 1016.
   b. Body Material: Solid brass.
   c. Finish: Polished chrome plate.
   d. Maximum Flow Rate: 1.5 gpm unless otherwise indicated.
   e. Mounting: Concealed.
   f. Operation: Single-handle, twist or rotate control.
   g. Antiscald Device: Integral with mixing valve.
   h. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.
4. Supply Connections: NPS 1/2.
5. Shower Head:
   a. Standard: ASME A112.18.1/CSA B125.1.
   b. Type: Fixed head and Hand held.
      Diverter Valve: Required.
   c. Shower Head Material: Metallic with chrome-plated finish.
   d. Spray Pattern: Fixed.
   e. Integral Volume Control: Not required
   f. Provide with 36" slide bar.
   g. Shower-Arm, Flow-Control Fitting: Not required.
   h. Temperature Indicator: Not required.

2.2 SHOWER BASINS

A. Molded Stone Shower Basins: SH-1 & SH-2.

1. Swanstone or approved equal.
2. Source Limitations: Obtain shower basins from single source from single manufacturer.
3. Description: Molded-stone base for built-up-type shower fixture.
4. Standard: CSA B45.8/IAPMO Z403.
5. Type: Standard commercial and Handicapped/accessible.
6. Nominal Size and Shape: 36 by 36 inches square & 30 by 60 inches (accessible).
7. Color: White.
8. Outlet: Drain with NPS 2 outlet; lip drain outside shower in accordance with the ADA.

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 shower installation.

B. Examine walls and floors for suitable conditions where showers will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Assemble shower components according to manufacturers' written instructions.

B. Install showers level and plumb according to roughing-in drawings.

C. Install water-supply piping with stop on each supply to each shower faucet.
1. Exception: Use ball valves if supply stops are not specified with shower. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping."
2. Install stops in locations where they can be easily reached for operation.

D. Install shower flow-control fittings with specified maximum flow rates in shower arms.

E. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheons requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

F. Seal joints between showers and floors and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with traps and soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Operate and adjust showers and controls. Replace damaged and malfunctioning showers, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3.5 CLEANING AND PROTECTION

A. After completing installation of showers and basins, inspect and repair damaged finishes.

B. Clean showers and basins, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed fixtures and fittings.

D. Do not allow use of showers and basins for temporary facilities unless approved in writing by the District.

END OF SECTION

SECTION 224713 – DRINKING FOUNTAINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings 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 drinking fountains, bottle filler stations, and related components.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of drinking fountain.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
   2. Include operating characteristics, and furnished specialties and accessories.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For drinking fountains to include in maintenance manuals.

1.5 REGULAORY REQUIREMENTS

A. Accessible plumbing fixtures shall comply with all requirements in CBC Division 6.

B. Heights and locations of all accessible fixtures shall be mounted according to CBC Sections 11B-602 through 11B-612.

C. Accessible fixtures controls shall comply with CBC Sections 11B-602.3 for drinking fountains.

PART 2 - PRODUCTS

2.1 DRINKING FOUNTAINS

A. Drinking Fountains: Stainless steel, Bi-Level, Wall-mounted, with Bottle Filler, Accessible.
   1. Stainless-Steel Drinking Fountains, DF-1:
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Acorn Engineering, Inc.
2) Murdock #A172400S-UBL-VR-BF1S-WF3-.004.
3) Elkay Manufacturing Co.
4) Haws Corporation.
5) Or equal.

2. Standards:
   a. Comply with ASME A112.19.3/CSA B45.4.
   b. Comply with ADA-ABA Accessibility Guidelines and CBC; NSF 61 Annex G, NSF 372, and California Assembly Bill AB1953.
3. Type Receptor: Slab.
4. Receptor Shape: Rectangular.
5. Back Panel: Stainless-steel wall plate behind drinking fountain.
6. Bubblers: Two, with adjustable stream regulator, located on deck.
7. Control: Push button.
8. Bottle Filler: Two required.
9. Filter: NSF 42+53, 1-micron lead reduction, 3000-gallon capacity.
10. Drain: Grid type with NPS 1-1/4 tailpiece.
11. Supply: NPS 3/8 with shutoff valve.
12. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 chrome-plated brass P-trap and waste.
13. Support: Type II water cooler carrier.
14. Drinking Fountain Mounting Height: Disabled Access in accordance with ADA-ABA Accessibility Guidelines and the California Building Code.

2.2 SUPPORTS

A. Type II Water Cooler Carrier:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Jay R. Smith Mfg. Co.
      b. Josam Company.
      c. Watts; a Watts Water Technologies company.
      d. Or Equal.
   2. Standard: ASME A112.6.1M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.

B. Examine walls and floors for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install fixtures level and plumb according to roughing-in drawings. Install at heights indicated on Drawings.

B. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.

C. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523.12 "Ball Valves for Plumbing Piping."

D. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

E. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

F. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Install ball shutoff valve on water supply to each fixture. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping."

D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.

3.5 CLEANING

A. After installing fixtures, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

C. Provide protective covering for installed fixtures.

D. Do not allow use of fixtures for temporary facilities unless approved in writing by District.

END OF SECTION

SECTION 230010 – MECHANICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The General Conditions and Supplementary Conditions shall apply to and form part of this Division.

1.2 SUMMARY

A. Work includes, but is not limited to, the following:
   1. Labor, material, equipment and transportation to complete the Work as shown on the drawings, specified herein and/or implied thereby.
   2. A requirement of the plumbing sections shall be to provide make-up water and drain final connections to systems and equipment.
   3. It is the intent of the project that the installation be coordinated to provide a complete and usable facility.

B. Work not included in this division:
   1. Painting, except as hereinafter specified. See Division 9 for painting.
   2. Electrical, except for controls hereinafter specified. See Division 26 for electrical.

C. Related Sections include the following:
   1. Division 23 Section 230050 “Basic Mechanical Materials and Methods.”

1.3 DEFINITIONS

A. Unless otherwise specified, "all clarification from," "field direction by," "submittals to," "approved by," "processed by," "permission from," and like mentioned herein shall mean from/by/to Architect.

B. "Provide" means furnish and install referenced item with all appurtenances.

C. "Shall" indicates a mandatory requirement.

D. "Air conditioning" is defined as the treatment and/or handling of any air to any degree by the systems shown on the drawings and herein specified and is not restricted to refrigerated cooling.

1.4 DELIVERY AND STORAGE OF MATERIALS

A. Provide for the safety and good condition of all materials and equipment until final acceptance by the Owner. Protect all materials and equipment from damage from any cause whatever and provide adequate and proper storage facilities during the progress of the work. Replace all damaged and defective work, material or equipment

prior to filing application for final acceptance. Properly protect all openings to equipment, piping, ductwork, accessories, etc. from dirt, dust, and debris prior to and during installation of the work. Ductwork stored at the jobsite shall be covered to protect from dirt, dust, debris, fire proofing, etc.

1.5 CODES AND STANDARDS

A. Work and materials shall be in full accordance with the latest rules and regulations of the Local Fire Marshal; the California Electric Code (CEC); the California Plumbing Code; California Administrative Code, Title 24, (CAL/OSHA); Local Building Codes; the California Mechanical Code; Volume I and II of the California Building Code; and other applicable codes, laws or regulations of bodies lawfully empowered and having jurisdiction over this project. Nothing in the plans or specifications shall be construed to permit work not conforming to these codes. When codes conflict with one another, provide larger, higher or more restrictive standards without additional costs.

1.6 PERMITS

A. Obtain all permits, patent rights, and licenses that are required for the performing of this work by all laws, ordinances, rules and regulations, or orders of any officer and/or body. Provide all notices necessary in connection therewith, and pay all fees relating thereto and all costs and expenses incurred on account thereof. No work shall be covered before inspection by the jurisdictional authorities and observation by the Architect or the owner's designated representatives.

1.7 EXPLANATION AND PRECEDENCE OF DRAWINGS

A. Drawings and specifications are intended to be read together so that any work mentioned in one and not the other shall be executed the same as if mentioned in both.

B. For purposes of clearness and legibility, drawings are essentially diagrammatic. The size and location of equipment is drawn to scale wherever possible. Contractor shall make use of data in the contract documents and shall verify this information at the building site.

C. Where the contract specifications and/or drawings are in conflict, obtain clarification of such during bidding. Where addenda for clarification of such is not timely, base the bid on the higher standards or more restrictive requirements; prior to fabrication, obtain written clarification.

D. The drawings indicate required size and points of termination of pipes, and suggest proper routes to conform to structure, avoid obstructions and preserve clearances. It is not intended that drawings indicate necessary offsets. The Contractor shall make the installation in such a manner as to conform to the structure, avoid obstructions, preserve headroom and keep openings and passageways clear, without further instructions or costs to the Owner.

E. It is intended that apparatus be located symmetrical with architectural elements. Refer to architectural details in completing the correlating work.

F. The Contractor shall study drawings and specifications including, and not limited to, architectural, structural, mechanical, plumbing, fire protection, and electrical to determine conflict with ordinances and statutes. Errors or omissions shall be reported in writing, and changes shall be included in the as-built drawings and the additional work performed at no cost to the Owner.

G. Submittal of bid shall indicate the Contractor has examined the site and drawings and has included required allowances in his bid. No allowance shall be made for any error resulting from Contractor's failure to visit job site and to review drawings and specifications. Bid shall include costs for required drawings and changes as outline above, all at no cost to owner.

1.8 RECORD DRAWINGS

A. In addition for requirements for shop drawings specified elsewhere, provide and maintain on the job one complete set of blue line prints of the record drawings for all the mechanical and plumbing work. Carefully record on this set of prints, work including piping, valves, etc., which is installed differently from that indicated in the specifications and on the drawings; locate dimensionally from fixed points. The depth shall be indicated for all plugged wyes, tees and capped lines.

B. These record drawings shall be continuously kept up-to-date, and shall be available for inspection at all times. Existing lines discovered shall be indicated on these drawings.

C. At completion of work, provide a neat and legible reproducible set of these up-to-date record drawings which shall be individually signed and dated by the Contractor and the job inspector as to their accuracy.

D. Record drawings shall be submitted for acceptance and approval to the Architect and Mechanical Engineer before final certificate of acceptance will be issued.

E. Record drawings shall show the exact location of all control sensor devices.

1.9 CUTTING AND PATCHING

A. Perform all cutting and fitting required for work of this section in rough construction of the building. Obtain permission of the Structural Engineer prior to cutting any structural building elements.

B. All patching of finished construction of building shall be performed under the sections of specifications covering these materials by the trades at no additional cost to the Owner.

C. All cutting of concrete work by Contractor shall be by core drilling or concrete saw. No cutting or coring shall be done without first obtaining the permission of the Architect and Owner.

D. All patching of existing surfaces shall match existing material and finish.

1.10 DAMAGE BY LEAKS

A. Contractor shall be responsible for damage to the grounds, walks, roads, buildings, finishes, surfaces, materials, equipment, piping systems, electrical systems and their equipment and contents, caused by leaks in the piping systems being installed or having been installed herein. He shall repair at his expense all damage so caused. All repair work shall be done as directed by the Architect and Owner.

1.11 EMERGENCY REPAIRS

A. The Owner reserves the right to make emergency repairs as required to keep equipment in operation without voiding the Contractor's guarantee bond nor relieving the Contractor of his responsibilities.

1.12 LOCATIONS

A. Coordinate in advance of the work, requirements for openings, equipment maintenance clearances, recesses and chases in the walls, partitions, equipment housekeeping pads, framing or openings. Should furnishing this information be neglected, delayed or incorrect and additional cutting is found to be required, the cost of same shall be borne by the Contractor. Nothing in this paragraph shall be construed to relieve the Contractor of the responsibility for providing and paying for the required core drilling and openings in existing work.

B. Diagrammatic Indications on Drawings are:
   1. Approximate only.
   2. At various locations shown distorted for clarity.

C. Exact Locations Shall:
   1. Be as required for proper installation in available space.
   2. Avoid interference with architectural, electrical and structural features.
   3. Be coordinated with the work of other trades toward the general purpose of having the work progress rapidly and smoothly with a minimum interference between one trade and another.
   4. Preserve headroom and keep openings and passageways clear.
   5. Have a neat arrangement symmetrical to the building lines, light and tile pattern.
   6. Be reasonably accessible for hung ceiling areas for maintenance from the floor below. Equipment, valves, and other items requiring maintenance, adjustment and/or observation shall be accessible.

1.13 SUPPORTS, EQUIPMENT PADS, STAGING, ETC.

A. Construction supports required for the proper installation of equipment shall be in accordance with the drawings, manufacturer’s requirements, seismic requirements, and applicable codes. Check architectural and structural drawings for equipment

pads by others. Provide staging, scaffolds, platforms, ladders or similar facilities required to properly install the work.

1.14 INTERRUPTION OF UTILITIES

A. The Contractor shall schedule and coordinate all interruptions of utilities with the Architect and Owner within 30 days after award of contract. The Contractor shall submit to the Owner a schedule of proposed interruptions. At least 72 hours prior to the interruption, the contractor shall submit a request indicating the proposed date and duration of interruption, the work to be accomplished, the areas which will be affected and a proposed contingency plan to be followed in the event that normal service or facilities cannot be restored on schedule. Do not commence work until the time, date, and contingency have been approved in writing by the Architect and Owner.

B. Provide any labor and materials necessary to restore services on a contingency basis should normal service or facilities not be restored on schedule.

C. Preparatory work associated with each interruption shall be performed during normal work hours. The actual interruption required for tie-in shall be performed between 8 P.M. and 5 A.M. Maximum shutdown during this period of any system shall be 4 hours.

1.15 SUBSTITUTIONS

A. If substitutions of controls or equipment requires any changes in the architectural, structural, mechanical, plumbing or electrical work from that shown on the drawings(including all environmental characteristics), the extra cost of the equipment or architectural, structural, mechanical, plumbing or electrical work shall be responsibility of the Contractor requesting the substitution. All substitutions shall be approved by the Architect before purchase by the contractor.

B. If the Contractor proposes substitutions of any equipment specified herein or on the drawings, it shall be the Contractor's responsibility to obtain approval from the Architect for such equipment as well as approval for anchorage of such equipment from the Architect, Structural Engineer, and governing approval. All costs required for such approval shall be the responsibility of the Contractor requesting the substitution.

1.16 PREPARATION OF SUBMITTALS

A. Refer to Division 1. In addition to the requirements of Division 1, provide the requirements specified herein.

B. Prior to commencement of work and in accordance with the General Requirements, submit for review six copies of proposed equipment and material submittals. The Contractor shall verify the delivery dates are compatible with the specified construction schedule; and verify the equipment is sized to accommodate the conditions specified. Submittals shall include manufacturer’s names and model numbers and shall comply with specifications and drawings. The Contractor shall bear the cost of changes necessary to accommodate substitutions if substitution is approved.

C. Provide formal submittal to Architect. Review of the formal submittal is only for general conformance with design concept of project and general compliance with the information given in the contract documents. The Contractor is responsible for confirmation and correlation of the dimensions, quantities and sizes, for information that pertains to fabrication methods or construction techniques, and for coordination of work of all trades. Deviations from Drawings and Specifications shall be clearly and completely indicated (by a separate letter) in the formal submittals. Reviewed Submittals shall not relieve the Contractor of responsibility for errors or deviations.
   1. Where specific model numbers and/or manufacturers are specified or shown, it is the intent of the contract documents to procure the specified item(s). Alternate equipment may not be used unless data is submitted for consideration as a substitution in accordance with General Requirements and this section.
   2. Model numbers used may not indicate all features or options required for this specific installation. Modify the specified models to comply with the requirements, as specified or shown.
   3. Product Data for Proposed Substitutions:
      a. Submit copies of complete data, with drawings and samples as appropriate, including:
         1) Comparison of the qualities of the proposed substitution with that specified.
         2) Changes required in other elements of the work because of the substitution.
         3) Affect on construction schedule.
         4) Cost data comparing the proposed substitution with the product specified.
         5) Availability of maintenance service and source of replacement materials.
         6) Reference to three (3) projects similar to this where such equipment is installed and operating to two (2) or more years.
      b. Acceptance of substitutions is entirely at the discretion of the Architect.

D. Formal submittals shall be complete with catalog data and information properly marked to indicate equality of material (where substitution is allowed and desired), adequacy in capacity and performance to meet minimum capacities or performance as specified or indicated. Arrange the submittals in the same sequence as these Specifications and indicate the Section and Paragraph number (in the upper right-hand side with tabs) for which each submittal is intended. Incomplete submittals shall be rejected.

E. Do not fabricate order or deliver materials or equipment until formal submittals have been approved. Where material or equipment is used without such permission, it is deemed that the material or equipment shall be in complete compliance with drawings and specifications, without additional cost where such compliance is lacking and may be required to be altered in the field.

F. Submittals shall be bound and shall include, at a minimum, the following:
   1. Complete bill of materials listing equipment furnished.
   2. Catalog cut sheets of every component being provided (highlighted).
   3. Provide completed blue-line shop drawings of the packaged equipment detailing all field connection points.
   4. Dimensions, clearance requirements, weights, and capacities.

5. Wiring diagrams showing control interface as applicable.
6. Warranty sheets.
7. Pressure drops as applicable.

G. Contractor shall incur all costs for time spent by Engineer for review of more than two submittals on each item. Costs shall be based on Engineer's hourly billing rate schedule at the time of review. Rate schedule available upon request. Engineer shall invoice the contractor upon completion of review and shall be paid by the contractor within 30 days of date of invoice. Failure to remit will withdraw approval (if any) of submittals in question.

1.17 SHOP DRAWINGS:

A. Proceed with preparation of shop drawings immediately upon receiving an authorization to proceed for the project. Shop drawings shall be originally prepared by the contractor. Provide minimum 1/4" scale shop drawings in electronic format. Submit a complete set in one package prior to material fabrication, order and installation.

B. Include:
1. Duct and pipe elevations and sizes.
2. Double line ductwork and piping (4" and larger).
3. Actual size of purchased equipment from certified shop drawings.
4. Access panels including ceiling panels.
5. Access clearances for equipment.
6. Actual locations of ceiling diffusers/ supply registers ad return registers.
7. Actual locations of manual volume dampers.
8. Locations of structural penetrations such as beams.
9. Actual location of control panels and power connections to equipment.
10. Color coded duct and piping based on material used.
11. Label and tag schedule for equipment.
12. Duct transitions to clear beams or tight areas.
13. Room temperature sensor locations.
14. Point of connection to utilities outside the building.
15. Sections or 3-dimensional drawings of congested areas.
16. Gridlines.
17. Duct and piping supports on roof.

C. Coordinate with other trades in preparation of shop drawings.

D. Submit a copy of coordinated shop drawings to General Contractor for distribution to other trades, including electrical and fire sprinkler contractor.

E. Submit to commissioning agent for approval to assure design intent is met.

F. Prior to fabrication and upon receiving approval from commissioning agent, submit a complete set of shop drawings at one time to the mechanical engineer.

1.18 ELECTRICAL REQUIREMENTS

A. Coordinate the following items with Division 26:

1. Power wiring
2. Power Supply Voltage Requirements
3. Safety switches
4. Combination controllers
5. Disconnect switches
6. Motor starters
7. Circuit breakers
8. Motor-control equipment forming part of motor control centers or switchgear assemblies
9. Electrical connections of the mechanical equipment to the electrical power source shall be coordinated with and provided under Division 26.

1.19 MOTORS

A. Before order is placed for electrical devices, the Contractor shall check with the Electrical contractor and verify requirements as to type, mounting and current characteristics as well as to any special delivery instructions. Motors provided under Division 23 shall be minimum of 10% normal rating above brake horsepower (BHP) rating of equipment driven.

1.20 TESTS

A. Contractor shall make tests required by legally constituted authorities and as listed below.
   1. Tests shall be made in the presence of the Owner or his representative and a duly authorized inspector. The Owner or his representative shall be notified 5 days before tests are made.
   2. Concealed work and insulated work shall remain uncovered until required testing has been performed and approved by the Owner. If work to be tested is covered before the approval of the Owner or his authorized representative has been obtained, it shall be uncovered for testing at the Contractor's expense.
   3. Obtain required documents of certification indicating approval, acceptance and compliance with the requirements of all administrative authorities having jurisdiction over the work. No final payment shall be made until all such certificates are delivered to the Owner.
   4. Furnish labor, materials, instruments and bear other costs in connection with all tests.
   5. Piping systems, except as hereinafter noted, shall be given hydrostatic (with water) test of a least 150% of the maximum operating pressure but no less than 150 psig.
   6. Before making test, remove or valve off from the system, gauges, traps, and other apparatus or equipment which may be damaged by test pressure.
   7. Install a calibrated test pressure gauge in the system to observe any loss in pressure. Maintain the required test pressure for a sufficient length of time to enable an inspection to be made of all joints and connections. Perform tests after installation and prior to acceptance.
   8. Final pressures at the end of the test period shall be no more or less than that caused by expansion or contraction of the test medium due to temperature changes.

9. After tests have been made and leaks repaired, clean and flush systems as hereinafter specified. Water piping shall be left under supply main pressure for the balance of the construction period.
10. Tests for mechanical, plumbing, and fire protection systems are specified within their own section. Equipment and ductwork system tests are specified in the test and balance section.
11. Provide necessary provisions and tests for maintaining the operational condition and cleanliness of existing systems.

1.21 LABOR AND MATERIALS

A. Labor shall be carefully skilled for this kind of work, and under the direction of a competent foreman.

B. Materials shall be new, in perfect condition and of domestic manufacturer. Materials for similar uses to be of same type and manufacturer.

C. Equipment shall bear the manufacturer's label showing performance characteristics. Identifying size number shall be given only when it is not practicable or customary to show performance characteristics.

D. Valves, pipe, fittings, etc., shall bear the manufacturer's name or trademark.

E. Unless otherwise specified herein, equipment and fixtures shall be installed in accordance with the manufacturer's recommendations, including recommended service and removal clearances.

1.22 PROTECTION AND CLEAN-UP

A. Protection: Provide for the safety and good condition of materials and equipment until final acceptance of the Architect. Protect materials and equipment from dirt, dust, debris, and damage from any cause whatever, and provide adequate and proper storage facilities during the progress of the work and replace all damaged and defective material, equipment or work precedent to filing application for final acceptance.

B. Cleaning:
1. Unless a more stringent requirement is specified, thoroughly clean all parts of the piping, ductwork, fixtures, apparatus and equipment. All parts shall be thoroughly cleaned of dirt, dust, debris, cement, plaster and other materials, and all grease and oil spots removed. Such surfaces shall be carefully wiped and all cracks and corners scraped out. Clean all systems, including piping and ductwork prior to test.
2. Exposed rough metal work shall be carefully brushed down with steel brushes to remove rust and other spots and left in clean condition to receive painter's finish. Where factory prime coat has been damaged, this Contractor shall be responsible for restoration of same.

1.23 ACCESS PANELS

A. Access Doors and Panels:
   1. Wherever volume dampers, fire dampers, smoke fire dampers, controls, valves or other items or parts of the installation which require periodic inspection or adjustments are concealed by permanent non-removable construction, an access door shall be provided. Rating of access panel shall be determined by rating of wall or ceiling in which panel is installed. Types to be as approved and as appropriate for the surface and construction in which it is installed. Verify all locations with Architect and other trades.
   2. Access doors and panels shall be of sufficient size and shall be located properly to assure service to the intended item.

1.24 MAINTENANCE, OPERATION INSTRUCTION

A. General: Thoroughly instruct the Owner's operators in every detail of operation of the system. Provide the Owner with a list of all equipment, giving the manufacturer's name, model number, serial number, parts list and complete internal wiring diagrams. All directions for operation furnished by the manufacturer shall be carefully saved and turned over to the Owner, together with written sequence of operation, operating and maintenance instructions for each system and its equipment. Instruction shall consist of a minimum of four 8-hour periods over consecutive days and shall be 30% classroom and 70% at site location. Coordinate scheduling of instruction times with Owner's operators.

B. Specific Data: Submit four complete sets of the following data to the Owner for approval and commissioning agent for review prior to acceptance of the installation, complete and at one time; (partial or separate data will not be accepted) data shall consist of the following:
   1. Valve Directory: Indicating valve number, location, function and normal operating position for each.
   2. Color code schedule.
   3. Equipment: List of name plates, including name plate data.
   4. Manufacturer's Literature: Copies of manufacturer's instructions for operation and maintenance of all mechanical equipment, including replacement parts lists and drawings. Mark or highlight brochure literature indicating the models, sizes, capacities, curve operating points, etc., in a manner to clearly indicate the equipment installed. Remove all pages or sheets from the bulletin and catalogs that do not pertain to equipment installed on the project.
   5. Written Instructions: Typewritten instructions for operation and maintenance of the system composed of OPERATING INSTRUCTIONS, MAINTENANCE INSTRUCTIONS and a MAINTENANCE SCHEDULE.
      a. OPERATING INSTRUCTIONS shall contain a brief description of the system. Adjustments requiring the technical knowledge of the service agency personnel shall not be included in the operating instructions. The fact such adjustments are required, however, shall be noted.
      b. MAINTENANCE INSTRUCTIONS shall list each item of equipment requiring inspection, lubrication or service and describe the performance of such maintenance.
      c. MAINTENANCE SCHEDULE shall list each item of equipment requiring maintenance, shall show the exact type of maintenance on every

component of each item of equipment, and shall show when each item of equipment should be inspected or services.

6. Instructions: Operating personnel shall be instructed in the operation of the system in accordance with typewritten, approved instructions.

C. Binders: Provide complete sets of the above data in loose-leaf ring-type binders with permanent covers, with identification on front and on spine.

1.25 SPECIAL REQUIREMENTS

A. During the guarantee period and as directed by the Owner, make any additional tests, adjustment, etc., that may be required and correct any defects or deficiencies arising from operation of the systems. Operational tests shall be made during both heating and cooling seasons and on all systems.

B. Completion:
1. The entire mechanical system shall be commissioned in accordance with ASHRAE Guideline 1-1996 and the requirements of this specification. A final commissioning report shall be approved by the Owner, Architect, and Mechanical Engineer prior to final acceptance of the work.
2. When the installation is complete and adjustments specified herein have been made, the system, shall be operated for a period of one week, during which time it shall be demonstrated to the Owner or his representative as being completed and operating in conformance with these specifications. The Contractor shall schedule all work so that this time period, which is to confirm a "bug-free" system, will occur before the total project is accepted for substantial completion by Owner.
3. The work hereunder shall not be reviewed for final acceptance until operating and maintenance data, manufacturer's literature, valve directories, piping identification code directory, and nameplates specified herein have been approved and properly posted in the building.

1.26 WARRANTY/GUARANTEE

A. The contractor shall warranty/guarantee that materials, apparatus, and equipment furnished and installed under the mechanical division of these specifications shall be new and free from all defects. Should any defects develop, within one year (unless a longer period is listed in other sections of the specifications) from the date of final acceptance by the owner or from the date of certificate of substantial completion, whichever is earlier, due to inferior or faulty materials and/or workmanship, the trouble shall be corrected by this Contractor without expense to the Owner. Any defective materials or inferior workmanship noticed at the time of installation or during the guarantee period shall be corrected immediately to the entire satisfaction of the Owner.

B. The work shall be installed of such materials and in such a manner that:
1. The operation of all parts of the system shall be noiseless to the extent that no objectionable sound of operation will be heard outside of the rooms enclosing the apparatus or equipment.

2. Apparatus or equipment shall operate in accordance with detailed specifications covering each item.
3. Contractor shall, at his own expense, make any adjustments or changes required to produce a condition of quietness satisfactory to the Engineer or his representative. Such adjustments or changes shall not reduce the performance or quantities called for on the drawings.
4. Contractor shall guarantee that his installation of all materials and equipment will meet the performance requirements of these specifications and that all equipment will deliver the specified or required capacities.
5. The Owner reserves the right to make temporary or emergency repairs as necessary to keep equipment in operating condition without voiding the guarantee contained herein nor relieving the Contractor of his responsibilities during the guarantee period.
6. Contractor shall be responsible for all damage to any part of the premises caused by leaks or break in pipe lines, fixtures or equipment furnished and installed under his contract for a period of one year after date of acceptance of the project by Owner. He shall replace in kind, at his own expense, any and all items so damaged to the complete satisfaction of the Owner.

1.27 CALIFORNIA GREEN BUILDING COMPLIANCE

A. In mechanically ventilated buildings, provide occupied areas of building with air filtration media for outside and return air prior to occupancy that provides at least MERV of 8 (Ref. Section 5.504.5.3).

B. Provide testing and adjusting of HVAC systems and controls per 5.713.10.4.

C. If the HVAC system is used during construction, return air filters with a MERV 8 rating shall be used per 5.714.4.1.

D. Installed HVAC equipment shall not contain CFC's or halons per 5.714.8.1.

END OF SECTION

SECTION 230050 – BASIC MECHANICAL MATERIALS AND METHODS

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 basic mechanical materials and methods to complement other Division 23 Sections.
   1. Piping materials and installation instructions common to most piping systems.
   2. Concrete base construction requirements.
   3. Escutcheons.
   4. Joining Materials.
   5. Dielectric fittings.
   6. Flexible connectors.
   7. Mechanical sleeve seals.
   8. Equipment nameplate data requirements.
   9. Labeling and identifying mechanical systems and equipment is specified in Division 23 Section "Identification for HVAC Piping and Equipment."
   10. Nonshrink grout for equipment installations.
   11. Field-fabricated metal and wood equipment supports.
   12. Installation requirements common to equipment specification sections.
   13. Cutting and patching.
   14. Touchup painting and finishing.

B. Related Requirements
   1. Pipe and pipe fitting materials are specified in Division 23 piping system Sections.
   2. Section 061000 “Rough Carpentry” for more information about lumber for wood curbs and wood for anchorage of mechanical equipment.

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, crawl spaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for rubber materials:
1. CR: Chlorosulfonated polyethylene synthetic rubber.
2. EPDM: Ethylene propylene diene terpolymer rubber.

1.4 SUBMITTALS

A. Product Data: For dielectric fittings, flexible connectors, mechanical sleeve seals, and identification materials and devices.

B. Shop Drawings: Detail fabrication and installation for metal and wood supports and anchorage for mechanical materials and equipment.

C. Coordination Drawings: For access panel and door locations.

D. Coordination Drawings: Detail major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the Work. Include the following:
1. Planned piping layout, including valve and specialty locations and valve-stem movement.
2. Clearances for installing and maintaining insulation.
3. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
4. Equipment and accessory service connections and support details.
5. Exterior wall and foundation penetrations.
6. Fire-rated wall and floor penetrations.
7. Sizes and location of required concrete pads and bases.
8. Scheduling, sequencing, movement, and positioning of large equipment into building during construction.
9. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
10. Reflected ceiling plans to coordinate and integrate installation of air outlets and inlets, light fixtures, communication system components, sprinklers, and other ceiling-mounted items.

E. Samples: Of color, lettering style, and other graphic representation required for each identification material and device.

1.5 QUALITY ASSURANCE

A. Equipment Selection: Equipment of higher electrical characteristics, physical dimensions, capacities, and ratings may be furnished provided such proposed

equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. Additional costs shall be approved in advance by appropriate Contract Modification for these increases. If minimum energy ratings or efficiencies of equipment are specified, equipment must meet design and commissioning requirements.

1.6 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 prevent entrance of dirt, debris, and moisture.

B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.

C. Protect flanges, fittings, and piping specialties from moisture and dirt.

D. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 SEQUENCING AND SCHEDULING

A. Coordinate mechanical equipment installation with other building components.

B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.

C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.

D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.

E. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.

F. Coordinate requirements for access panels and doors if mechanical items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section.

G. Coordinate installation of identifying devices after completing covering and painting if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.

1.8 CALIFORNIA GREEN BUILDING COMPLIANCE

A. In mechanically ventilated buildings, provide occupied areas of building with air filtration media for outside and return air prior to occupancy that provides at least MERV of 8 (Ref. Section 5.504.5.3).

B. Provide testing and adjusting of HVAC systems and controls per 5.713.10.4.

C. If the HVAC system is used during construction, return air filters with a MERV 8 rating shall be used per 5.714.4.1.

D. Installed HVAC equipment shall not contain CFC's or halons per 5.714.8.1.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Dielectric Unions:
      a. Epco Sales Inc.
      b. Watts Industries, Inc.; Water Products Div.
      c. Zurn Industries, Inc.; Wilkins Div.
   2. Dielectric Flanges:
      a. Epco Sales Inc.
      b. Watts Industries, Inc.; Water Products Div.
   3. Dielectric-Flange Insulating Kits:
      a. Calpico, Inc.
      b. Central Plastics Co.
   4. Dielectric Couplings:
      a. Calpico, Inc.
      b. Lochinvar Corp.
   5. Dielectric Nipples:
      a. Grinnell Corp.; Grinnell Supply Sales Co.
      b. Victaulic Co. of America.
   6. Mechanical Sleeve Seals:
      a. Calpico, Inc.
      b. Metraflex Co.
      c. Thunderline/Link-Seal.

2.2 PIPE AND PIPE FITTINGS

A. Refer to individual Division 23 piping Sections for pipe and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, unless thickness or specific material is indicated.
      a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
   2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32.
   1. Alloy E: Approximately 95 percent tin and 5 percent antimony, lead free.

F. Brazing Filler Metals: AWS A5.8.
   1. BCuP Series: Copper-phosphorus alloys.
   2. BAg1: Silver alloy.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Flanged, Ductile-Iron Pipe Gasket, Bolts, and Nuts: AWWA C110, rubber gasket, carbon-steel bolts, and nuts.

I. Couplings: Iron-body sleeve assembly, fabricated to match OD of plain-end, pressure pipes.
   1. Sleeve: ASTM A 126, Class B, gray iron.
   2. Followers: ASTM A 47 malleable iron or ASTM A 536 ductile iron.
   3. Gaskets: Rubber.
   4. Bolts and Nuts: AWWA C111.
   5. Finish: Enamel paint.

2.4 DIELECTRIC FITTINGS

A. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.

B. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld-neck end types and matching piping system materials.

C. Insulating Material: Suitable for system fluid, pressure, and temperature.

D. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

E. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

F. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
   1. Provide separate companion flanges and steel bolts and nuts for 150- or 300-psig minimum working pressure as required to suit system pressures.

G. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

H. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.5 MECHANICAL SLEEVE SEALS

A. Description: Modular design, with interlocking rubber links shaped to continuously fill annular space between pipe and sleeve. Include connecting bolts and pressure plates.

2.6 PIPING SPECIALTIES

A. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:
   1. Steel Sheet Metal: 0.0239-inch minimum thickness, galvanized, round tube closed with welded longitudinal joint.
   2. Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized, plain ends.
   3. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral water stop, unless otherwise indicated.
   4. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
      a. Underdeck Clamp: Clamping ring with setscrews.
   5. PE: Manufactured, reusable, tapered, cup shaped, smooth outer surface, with nailing flange for attaching to wooden forms.

B. Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type if required to conceal protruding fittings and sleeves.
   1. ID: Closely fit around pipe, tube, and insulation of insulated piping.
   2. OD: Completely cover opening.
   3. Cast Brass: Split casting, with concealed hinge and set screw.
      a. Finish: Rough brass.
      b. Finish: Polished chrome-plate.
   4. Stamped Steel: One piece, with spring clips and chrome-plated finish.
   5. Stamped Steel: Split plate, with concealed hinge, spring clips, and chrome-plated finish.
   6. Cast-Iron Floor Plate: One-piece casting.

2.7 GROUT

A. Nonshrink, Nonmetallic Grout: ASTM C 1107, Grade B.
   1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
   2. Design Mix: 5000-psig, 28-day compressive strength.
   3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. General: Install piping as described below, unless piping Sections specify otherwise. Individual Division 23 piping Sections specify unique piping installation requirements.

B. General Locations and Arrangements: 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 slope.

D. Install components with pressure rating equal to or greater than system operating pressure.

E. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.

F. Install piping free of sags and bends.

G. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.

H. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.

I. Install piping to allow application of insulation plus 1-inch clearance around insulation.

J. Locate groups of pipes parallel to each other, spaced to permit valve servicing.

K. Install fittings for changes in direction and branch connections.

L. Install couplings according to manufacturer's written instructions.

M. Install pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings according to the following:

1. Chrome-Plated Piping: Cast brass, one piece, with set screw, and polished chrome-plated finish.
2. Uninsulated Piping Wall Escutcheons: Cast brass or stamped steel, with set screw.
3. Uninsulated Piping Floor Plates in Utility Areas: Cast-iron floor plates.
4. Insulated Piping: Cast brass or stamped steel; with concealed hinge, spring clips, and chrome-plated finish.
5. Piping in Utility Areas: Cast brass or stamped steel, with set-screw or spring clips.

N. Sleeves are not required for core drilled holes.

O. Permanent sleeves are not required for holes formed by PE removable sleeves.

P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
1. Cut sleeves to length for mounting flush with both surfaces.
    a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
2. Build sleeves into walls and slabs as work progresses.
3. Install sleeves large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
    a. Steel Pipe Sleeves: For pipes smaller than 6-inch NPS.
    b. Steel, Sheet-Metal Sleeves: For pipes 6-inch NPS and larger, penetrating gypsum-board partitions.
    c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 7 Sections for flashing.
        1) Seal space outside of sleeve fittings with non-shrink, nonmetallic grout.
4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealants. Refer to Division 7 Sections for materials.
5. Use Type S, Grade NS, Class 25, Use O, neutral-curing silicone sealant, unless otherwise indicated.

Q. Aboveground, Exterior-Wall, Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches in diameter and larger.
3. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.

R. Underground, Exterior-Wall, Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Assemble and install mechanical sleeve seals according to manufacturer's written instructions. Tighten bolts that cause rubber sealing elements to expand and make watertight seal.

S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestopping materials. Refer to Division 7 Sections for materials.

T. Verify final equipment locations for roughing-in.

U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

V. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping specification Sections:
1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
3. Soldered Joints: Construct joints according to AWS's "Soldering Manual," Chapter "The Soldering of Pipe and Tube"; or CDA's "Copper Tube Handbook."
4. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
5. 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:
   a. Note internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
   b. Apply appropriate tape or thread compound to external pipe threads, unless dry seal threading is specified.
   c. Align threads at point of assembly.
   d. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
   e. 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.
6. Welded Joints: Construct joints according to AWS D10.12, "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe," using qualified processes and welding operators according to "Quality Assurance" Article.
7. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.

W. Piping Connections: Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping 2-inch NPS and smaller, adjacent to each valve and at final connection to each piece of equipment with 2-inch NPS or smaller threaded pipe connection.

2. Install flanges, in piping 2-1/2-inch NPS and larger, adjacent to flanged valves and at final connection to each piece of equipment with flanged pipe connection.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.2 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to provide maximum possible headroom, if mounting heights are not indicated.

B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to Architect.

C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

D. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

E. Install equipment giving right of way to piping installed at required slope.

F. Install flexible connectors on equipment side of shutoff valves, horizontally and parallel to equipment shafts if possible.

3.3 PAINTING AND FINISHING

A. Refer to Division 9 Section 099100 "Painting" for paint materials, surface preparation, and application of paint.

B. Apply paint to exposed piping according to the following, unless otherwise indicated:
1. Interior, Ferrous Piping: Use semigloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.
2. Interior, Galvanized-Steel Piping: Use semigloss, acrylic-enamel finish. Include two finish coats over galvanized metal primer.
3. Interior, Ferrous Supports: Use semigloss, acrylic-enamel finish. Include finish coat over enamel undercoat and primer.
4. Exterior, Ferrous Piping: Use semigloss, acrylic-enamel finish. Include two finish coats over rust-inhibitive metal primer.
5. Exterior, Galvanized-Steel Piping: Use semigloss, acrylic-enamel finish. Include two finish coats over galvanized metal primer.
6. Exterior, Ferrous Supports: Use semigloss, acrylic-enamel finish. Include two finish coats over rust-inhibitive metal primer.

C. Paint visible sheet metal behind ceiling inlets and outlets flat black.

D. Do not paint piping specialties with factory-applied finish.

E. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000-psig, 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section 033000 "Cast-in-Place Concrete."

3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

B. Field Welding: Comply with AWS D1.1, "Structural Welding Code-Steel."

3.6 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage to support and anchor mechanical materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.7 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of trades involved.

B. Repair cut surfaces to match adjacent surfaces.

3.8 GROUTING

A. Install nonmetallic, non-shrink, grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's written instructions.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placing of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases to provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout according to manufacturer's written instructions.

END OF SECTION

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.

B. Related Sections:
1. Section 230548 "Vibration and Seismic Controls for HVAC" for vibration isolation devices.
2. Section 233113 "Metal Ducts" for duct hangers and 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.
3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following: include Product Data for components:
   1. Trapeze pipe hangers.
   2. Metal framing systems.
   3. Pipe stands.
   4. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   1. Detail fabrication and assembly of trapeze hangers.
   2. Design Calculations: Calculate requirements for designing trapeze hangers.

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 or stainless steel.

B. Stainless-Steel Pipe Hangers and Supports:
   1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
   2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
   3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe Hangers:
1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel or stainless 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 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Allied Tube & Conduit.
b. Flex-Strut Inc.
c. Thomas & Betts Corporation.
d. Unistrut Corporation; Tyco International, Ltd.
2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or stainless steel.
7. Metallic Coating: Hot-dipped galvanized or Mill galvanized.
8. Paint Coating: Vinyl alkyd, Epoxy, Polyester, Acrylic or Alkyd.
9. Plastic Coating: Polyurethane, Epoxy or Polyester.

B. Non-MFMA Manufacturer Metal Framing Systems:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Anvil International; a subsidiary of Mueller Water Products Inc.
b. Haydon Corporation; H-Strut Division.
c. NIBCO INC.
2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
7. Coating: Zinc or Paint.

2.4 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Carpenter & Paterson, Inc.
   2. Clement Support Services.
   3. ERICO International Corporation.
   4. PHS Industries, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig (688-kPa), minimum compressive strength.

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.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.6 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

D. High-Type, Single-Pipe Stand:
   1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
   2. Base: Stainless steel.

3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand:
1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: One or more; plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.7 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.8 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, non-shrink and nonmetallic grout; suitable for interior and exterior applications.
1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

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. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:
   1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
   2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Pipe Stand Installation:
   1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
   2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 061000 “Rough Carpentry" for curbs.

G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

J. Install lateral bracing with pipe hangers and supports to prevent swaying.

K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65) and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

M. 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.

N. 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. 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.
   b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
   c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 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 metal framing systems and attachments for general service applications.

F. Use stainless-steel or corrosion-resistant attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal-hanger shield inserts for insulated piping and tubing.

J. 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.

K. 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.

L. 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.

M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    a. Light (MSS Type 31): 750 lb (340 kg).
    b. Medium (MSS Type 32): 1500 lb (680 kg).
    c. Heavy (MSS Type 33): 3000 lb (1360 kg).
13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.

14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

N. 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.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION

SECTION 230548 – VIBRATION AND SEISMIC CONTROLS 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. Elastomeric isolation pads. See detail 1/M5.01 and 2/M5.02.
2. Housed-restrained-spring isolators. See detail 2/M5.01 and 8/M5.01.
3. Pipe-riser resilient supports. See detail 9/M5.01.
4. Resilient pipe guides. See detail 9/M5.01.
5. Restraint cables. See detail 2/M5.00 and 8/M5.01
6. Seismic-restraint accessories. See detail 3/M5.01.
7. Mechanical anchor bolts. See detail 8/M5.01and 2/M5.02.

B. Related Requirements:
1. Section 220548 "Vibration and Seismic Controls for Plumbing" for devices for plumbing equipment and systems.

1.3 DEFINITIONS

A. CBC: California Building Code.

B. ICC-ES: ICC-Evaluation Service.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required.
   a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES, or an agency acceptable to authorities having jurisdiction.
   b. Annotate to indicate application of each product submitted and compliance with requirements.
3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Shop Drawings:
   1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
   2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

B. Qualification Data: For professional Engineer and testing agency.

C. Welding certificates.

D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Provide a letter by manufacturer representative that all vibration control devices are installed per manufacturer's instructions.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the CBC unless requirements in this Section are more stringent.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval 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 unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:
1. Site Class as Defined in the CBC: A, B, C, D, E or F.
2. Assigned Seismic Use Group or Building Category as Defined in the CBC: II.
   a. Component Importance Factor: 1.0.
   b. Component Response Modification Factor: 2.0.
   c. Component Amplification Factor: 2.5.
3. Design Spectral Response Acceleration at Short Periods (0.2 Second).
4. Design Spectral Response Acceleration at 1.0-Second Period.
5. 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.
   a. 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 are subjected.

2.2 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. California Dynamics Corporation.
   b. Kinetics Noise Control, Inc.
   c. Mason Industries, Inc.
2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
3. Size: Factory or field cut to match requirements of supported equipment.
4. Pad Material: Oil and water resistant with elastomeric properties.
5. Surface Pattern: Smooth, Ribbed or Waffle pattern.
6. Infused nonwoven cotton or synthetic fibers.
7. Load-bearing metal plates adhered to pads.
8. Sandwich-Core Material: Resilient and elastomeric.
   a. Surface Pattern: Waffle pattern.
   b. Infused nonwoven cotton or synthetic fibers.

2.3 HOUSED-RESTRAINED-SPRING ISOLATORS

A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing:
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. California Dynamics Corporation.
   b. Kinetics Noise Control, Inc.
   c. Mason Industries, Inc.

2. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.
    a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig (3447 kPa).
    b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.4 PIPE-RISER RESILIENT SUPPORT

A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch- (13-mm-) thick neoprene .
    1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
    2. Maximum Load Per Support: 500 psig (3.45 MPa)on isolation material providing equal isolation in all directions.

2.5 RESILIENT PIPE GUIDES

A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch- (13-mm-) thick neoprene.
    1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and re-insertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.6 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:
    1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
        a. California Dynamics Corporation.
        b. Kinetics Noise Control, Inc.
        c. Mason Industries, Inc.
    2. 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.
    3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
    4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
    5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
9. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

2.7 RESTRAINT CABLES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. Kinetics Noise Control, Inc.
   2. Loos & Co., Inc.
   3. Vibration Mountings & Controls, Inc.

B. Restraint Cables: ASTM A 603 galvanized or ASTM A 492 stainless-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.8 SEISMIC-RESTRAINT ACCESSORIES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. Cooper B-Line, Inc.
   2. Kinetics Noise Control, Inc.
   3. Mason Industries, Inc.
   4. TOLCO.
   5. Or approved equal.

B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or Reinforcing steel angle clamped to hanger rod.

C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.

D. 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.

E. 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.

F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.9 MECHANICAL ANCHOR BOLTS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. Cooper B-Line, Inc.
   2. Hilti, Inc.
   3. Kinetics Noise Control, Inc.
   4. Mason Industries, Inc.

B. 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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic- and wind-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

D. Provide a letter by manufacturer's representative that all vibration control devices are installed in full compliance with manufacturer's instruction.

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 is adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

C. Comply with requirements in Section 061000 “Rough Carpentry" for installation of roof curbs, equipment supports, and roof penetrations.

D. Equipment Restraints:
   1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
   2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
   3. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES OSHPD an agency acceptable to authorities having jurisdiction that provides required submittals for component.

E. 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).

F. Install cables so they do not bend across edges of adjacent equipment or building structure.

G. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES, or an agency acceptable to authorities having jurisdiction that provides required submittals for component.

H. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

I. 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.

J. 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 wood members.

K. 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 232113 "Hydronic Piping" 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 post-connection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test 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. Test and adjust restrained-air-spring isolator controls and safeties.

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.

3.7 VIBRATION ISOLATION EQUIPMENT BASES INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

END OF SECTION

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. Warning signs and labels.
3. Pipe labels.
4. Duct labels.
5. Stencils.
6. Valve tags.
7. Warning tags.

1.3 ACTION 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. Metal Labels for Equipment:
1. Material and Thickness: Brass, 0.032-inch (0.8-mm) or anodized aluminum, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. 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).
3. 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.
4. Fasteners: Stainless-steel rivets or self-tapping screws .
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 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.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Yellow.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).

E. 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).

F. 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.

G. Fasteners: Stainless-steel rivets or self-tapping screws .

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
   2. Lettering Size: At least 1-1/2 inches (38 mm)high.

2.4 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: White.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).

E. 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).

F. 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.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
   2. Lettering Size: At least 1-1/2 inches (38 mm)high.

2.5 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches (32 mm) for ducts; and minimum letter height of 3/4 inch (19 mm) for access panel and door labels, equipment labels, and similar operational instructions.
   1. Stencil Material: Fiberboard or metal.
   2. Stencil Paint: Exterior, gloss, alkyd enamel or acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
   3. Identification Paint: Exterior, alkyd enamel or acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.6 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) or anodized aluminum, 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.

2.7 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
   1. Size: Approximately 4 by 7 inches (100 by 178 mm).
   2. Fasteners: Brass grommet and wire or Reinforced grommet and wire or string.
   3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
   4. Color: Yellow background with black lettering.

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. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles on each piping system.
   1. Identification Paint: Use for contrasting background.
   2. Stencil Paint: Use for pipe marking.

B. 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.

C. Pipe Label Color Schedule:
   1. Chilled-Water Piping:
      a. Background Color: Black.
      b. Letter Color: White.
   2. Heating Water Piping:
      a. Background Color: Black.
      b. Letter Color: White.

3.4 DUCT LABEL INSTALLATION

A. Install plastic-laminated or self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
   1. Blue: For cold-air supply ducts.
   2. Yellow: For hot-air supply ducts.
   3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
   4. ASME A13.1 Colors and Designs: For hazardous material exhaust.

B. Stenciled Duct Label Option: Stenciled labels, showing service and flow direction, may be provided instead of plastic-laminated duct labels, at Installer's option, if lettering larger than 1 inch (25 mm) high is needed for proper identification because of distance from normal location of required identification.

C. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet (15 m) in each space where ducts are exposed or concealed by removable ceiling system.

3.5 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. Chilled Water: 2 inches (50 mm), round.
      b. Hot Water: 2 inches (50 mm), round .
      c. Gas: 2 inches (50 mm), round.
   2. Valve-Tag Color:
      a. Chilled Water: Natural or Green.
      b. Hot Water: Natural or Green.
      c. Gas: Yellow.
   3. Letter Color:
      a. Chilled Water: Black.

b. Hot Water: Black.
c. Gas: Black.

3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to equipment and other items where required.

END OF SECTION

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.

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 or NEBB.
   1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC or NEBB.
   2. TAB Technician: Employee of the TAB contractor and who is certified by AABC or NEBB as a TAB technician.

B. TAB Conference: Meet with 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 Commissioning Authority.

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."

H. Provide 72 hour trend data for all systems.

1.6 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. 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 TAB SPECIALISTS

A. Subject to compliance with requirements, engage an available TAB Contractor that is a member of AABC or NEBB.

3.2 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 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.

F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

G. Examine test reports specified in individual system and equipment Sections.

H. 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.

I. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

J. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.

K. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

M. Examine system pumps to ensure absence of entrained air in the suction piping.

N. Examine operating safety interlocks and controls on HVAC equipment.

O. 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.

3.3 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.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance", NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems", 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 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

E. Compile 72 hour trend data for all systems.

3.5 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."

3.6 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 Commissioning Authority 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.

3.7 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.

3.8 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

3.9 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 5 to Plus 10 percent.
   2. Air Outlets and Inlets: Plus or minus 10 percent.

3.10 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 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.

3.11 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.
   6. 72 hour trend data for all systems.

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. 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.
m. Vortex 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).
o. Inlet steam pressure in psig (kPa).

G. Fan Test Reports: For supply, return, and exhaust fans, include the following:
1. Fan Data:
a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches (mm), and bore.
h. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).

2. Motor Data:
a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches (mm), and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):
a. Total airflow rate in cfm (L/s).
b. Total system static pressure in inches wg (Pa).
c. Fan rpm.
d. Discharge static pressure in inches wg (Pa).

e. Suction static pressure in inches wg (Pa).

H. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data:
a. System and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F (deg C).
d. Duct static pressure in inches wg (Pa).
e. Duct size in inches (mm).
f. Duct area in sq. ft. (sq. m).
g. Indicated 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).

I. Instrument Calibration Reports:
1. Report Data:
a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.12 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 Commissioning Authority.
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Commissioning Authority.
3. 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.

3.13 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

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 insulating the following duct services:
   1. Indoor, concealed supply.
   2. Indoor, exposed supply.
   3. Indoor, concealed return located in unconditioned space.
   4. Indoor, exposed return located in unconditioned space.

B. Related Sections:
   1. Section 230719 "HVAC Piping Insulation."
   2. Section 233113 "Metal Ducts" for duct liners.

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 insulation application at elbows, fittings, dampers, specialties, and flanges for each type of insulation.
   3. Detail application of field-applied jackets.
   4. Detail application at linkages of control devices.

C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
   1. Sheet Form Insulation Materials: 12 inches (300 mm) square.
   2. Sheet Jacket Materials: 12 inches (300 mm) square.
   3. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

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 duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installation. 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 "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Duct liner shall be fungi and bacteria resistant to not breed nor promote growth.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I; Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Johns Manville; Microlite.
      b. Knauf Insulation; Friendly Feel Duct Wrap.
      c. Manson Insulation Inc.; Alley Wrap.
      d. Owens Corning; SOFTR All-Service Duct Wrap.

F. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA, or Type IB. For duct and plenum applications, provide insulation without factory-applied jacket, with factory-applied ASJ or with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Johns Manville; 800 Series Spin-Glas.
      b. Knauf Insulation; Insulation Board.
      c. Owens Corning; Fiberglas 700 Series.

2.2 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, provide one of the following:
      a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.Eagle Bridges - Marathon Industries; 225.
      b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.Mon-Eco Industries, Inc.; 22-25.
   2. 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).
   3. 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. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
      b. Eagle Bridges - Marathon Industries; 225.
      c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.Mon-Eco Industries, Inc.; 22-25.
   2. 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).
   3. 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."

2.3 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: Solvent based; suitable for outdoor use on below ambient services.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
      b. Eagle Bridges - Marathon Industries; 570.
      c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.
   2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
   3. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
   4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
   5. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
      b. Eagle Bridges - Marathon Industries; 550.
      c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
   2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.

3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.4 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
   1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
      b. Vimasco Corporation; 713 and 714.
   3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
   4. Service Temperature Range: 0 to plus 180 deg F (Minus 18 to plus 82 deg C).
   5. Color: White.

2.5 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.Eagle Bridges - Marathon Industries; 405.
      b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
      c. Mon-Eco Industries, Inc.; 44-05.
   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, 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. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 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, 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."

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. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. Metal Jacket:
1. Products: Subject to compliance with requirements, provide the following provide one of the following:
a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
c. RPR Products, Inc.; Insul-Mate.
2. 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 or factory cut and rolled to size.
b. Finish and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper .
d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.

C. 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 crosslaminated polyethylene film covered with white or stucco-embossed aluminum-foil facing.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Polyguard Products, Inc.; Alumaguard 60.

2.8 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. ABI, Ideal Tape Division; 428 AWF ASJ.
      b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
      c. Compac Corporation; 104 and 105.
      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.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. ABI, Ideal Tape Division; 491 AWF FSK.
      b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
      c. Compac Corporation; 110 and 111.
      d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
   2. Width: 3 inches (75 mm).
   3. Thickness: 6.5 mils (0.16 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. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. ABI, Ideal Tape Division; 488 AWF.
      b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
      c. Compac Corporation; 120.
      d. Venture Tape; 3520 CW.
   2. Width: 2 inches (50 mm).
   3. Thickness: 3.7 mils (0.093 mm).
   4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
   5. Elongation: 5 percent.
   6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.9 SECUREMENTS

A. Bands:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. ITW Insulation Systems; Gerrard Strapping and Seals.
      b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.

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.
   a. Products: Subject to compliance with requirements, provide one of the following:
      1) AGM Industries, Inc.; CWP-1.
      2) GEMCO; CD.
      3) Midwest Fasteners, Inc.; CD.
      4) Nelson Stud Welding; TPA, TPC, and TPS.
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.
   a. Products: Subject to compliance with requirements, provide the following provide one of the following:
      1) AGM Industries, Inc.; CHP-1.
      2) GEMCO; Cupped Head Weld Pin.
      3) Midwest Fasteners, Inc.; Cupped Head.
      4) Nelson Stud Welding; CHP.
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. Products: Subject to compliance with requirements, provide one of the following:
      1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
      2) GEMCO; Perforated Base.
      3) Midwest Fasteners, Inc.; Spindle.
   b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
   c. Spindle: Copper- or zinc-coated, low-carbon steel, aluminum or stainless steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
   d. 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, galvanized-steel, aluminum, or stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than in diameter.
   a. Products: Subject to compliance with requirements, provide one of the following:
      1) AGM Industries, Inc.; RC-150.
      2) GEMCO: R-150.

3) Midwest Fasteners, Inc.; WA-150.
4) Nelson Stud Welding; Speed Clips.

b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

5. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than in diameter.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) GEMCO.
      2) Midwest Fasteners, Inc.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

D. Wire: 0.080-inch (2.0-mm) nickel-copper alloy, 0.062-inch (1.6-mm) soft-annealed, stainless steel, 0.062-inch (1.6-mm) soft-annealed, galvanized steel.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. C & F Wire.

2.10 CORNER ANGLES

A. 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.

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.

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.

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 ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Install rigid duct to eliminate condensate buildup on the exterior of ductwork.

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.

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). Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 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 duct 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.

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 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.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches (50 mm).
   1. Comply with requirements in Section 078413 "Penetration Firestopping" and fire-resistive joint sealers.

E. Insulation Installation at Floor Penetrations:
   1. Duct: 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. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
   1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
   2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
   3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
      a. On duct sides with dimensions 18 inches (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 overcompress 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 one edge and one 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 two times the insulation thickness, but not less than 3 inches (75 mm).
   5. Overlap unfaced 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.

B. 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 overcompress 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 one edge and one 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 two 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.

3.6 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.

3.7 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099100 " Painting and Coating."
   1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
      a. Finish Coat Material: Interior, flat, latex-emulsion size.

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.

3.8 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.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.9 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:
   1. Indoor, concealed supply.
   2. Indoor, exposed supply.
   3. Indoor, concealed return located in unconditioned space.
   4. Indoor, exposed return located in unconditioned space.

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.

3.10 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, round and flat-oval, supply-air duct insulation shall be one of the following:
1. Mineral-Fiber Blanket: 2 inches (50 mm) thick and 0.75-lb/cu. ft. nominal density.

B. Concealed, round and flat-oval, return-air duct insulation shall be one of the following:
1. Mineral-Fiber Blanket: 2 inches (50 mm) and 0.75-lb/cu. ft. nominal density.

C. Concealed, rectangular, supply-air duct insulation shall be one of the following:
1. Mineral-Fiber Blanket: 2 inches (50 mm) .75-lb/cu. ft. nominal density.

D. Concealed, rectangular, return-air duct insulation shall be one of the following:
1. Mineral-Fiber Blanket: 2 inches (50 mm) .75-lb?cu. ft. nominal density.

E. Concealed, supply-air plenum insulation shall be one of the following:
1. Mineral-Fiber Blanket: 2 inches (50 mm) -0.75 lb/cu. ft. nominal density.

F. Concealed, return-air plenum insulation shall be one of the following:
1. Mineral-Fiber Blanket: 2 inches (50 mm) .75-lb/cu. ft. nominal density.

G. Exposed, round and flat-oval, supply-air duct insulation shall be one of the following:
1. Mineral-Fiber Blanket: 2 inches (50 mm) thick and 0.75-lb/cu. ft. nominal density.

H. Exposed, rectangular, supply-air duct insulation shall be one of the following:
1. Mineral-Fiber Blanket: 2 inches (50 mm) .75-lb/cu. ft. nominal density.

3.11 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. Ducts and Plenums, Concealed:
1. Foil & Paper.

D. Ducts and Plenums, Exposed:
1. Foil & Paper.

END OF SECTION

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. Condensate drain piping, indoors and outdoors.
   2. Refrigerant suction and hot-gas piping, indoors and outdoors.

B. Related Sections:
   1. Section 230713 "Duct Insulation."

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 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.
   6. Detail application of field-applied jackets.
   7. Detail application at linkages of control devices.

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. Calcium Silicate:
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. Industrial Insulation Group (IIG); Thermo-12 Gold.
2. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
3. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
4. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

G. 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. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Pittsburgh Corning Corporation; Foamglas.
2. Block Insulation: ASTM C 552, Type I.
3. Special-Shaped Insulation: ASTM C 552, Type III.
4. Board Insulation: ASTM C 552, Type IV.
5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
6. Preformed Pipe Insulation with Factory-Applied ASJ ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

H. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
1. Products: Subject to compliance with requirements, provide one of the following:

a. Aeroflex USA, Inc.; Aerocel.
b. Armacell LLC; AP Armaflex.
c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

I. 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 I, or II with factory-applied vinyl jacket, III with factory-applied FSK jacket or III with factory-applied FSP jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the following:
a. CertainTeed Corp.; SoftTouch Duct Wrap.
b. Johns Manville; Microlite.
c. Knauf Insulation; Friendly Feel Duct Wrap.
d. Manson Insulation Inc.; Alley Wrap.
e. Owens Corning; SOFTR All-Service Duct Wrap.

J. Mineral-Fiber, Preformed Pipe Insulation:
1. Products: Subject to compliance with requirements, provide one of the following:
a. Johns Manville; Micro-Lok.
b. Knauf Insulation; 1000-Degree Pipe Insulation.
c. Manson Insulation Inc.; Alley-K.
d. 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, without factory-applied jacket, with factory-applied ASJ or with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
3. Type II, 1200 deg F (649 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type II, Grade A, without factory-applied jacket, with factory-applied ASJ or with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

K. Mineral-Fiber, Pipe Insulation Wicking System: Preformed pipe insulation complying with ASTM C 547, Type I, Grade A, with absorbent cloth factory-applied to the entire inside surface of preformed pipe insulation and extended through the longitudinal joint to outside surface of insulation under insulation jacket. Factory apply a white, polymer, vapor-retarder jacket with self-sealing adhesive tape seam and evaporation holes running continuously along the longitudinal seam, exposing the absorbent cloth.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Knauf Insulation; Permawick Pipe Insulation.
b. Owens Corning; VaporWick Pipe Insulation.

L. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ or FSK jacket complying with ASTM C 1393, Type II, or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. (40 kg/cu. m) or more. Thermal conductivity (k-value) at 100 deg F (55 deg C) is 0.29 Btu x in./h x sq. ft. x deg F (0.042 W/m x K) or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the following:
a. CertainTeed Corp.; CrimpWrap.
b. Johns Manville; MicroFlex.

c. Knauf Insulation; Pipe and Tank Insulation.
d. Manson Insulation Inc.; AK Flex.
e. Owens Corning; Fiberglas Pipe and Tank Insulation.

M. Phenolic:
1. Products: Subject to compliance with requirements, provide one of the following:
a. Kingspan Tarec Industrial Insulation NV; Koolphen K.
b. Resolco International BV; Insul-phen.
2. Preformed pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type III, Grade 1.
3. Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C 1126, Type II, Grade 1.
4. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
5. Factory-Applied Jacket: Requirements are specified in "Factory-Applied Jackets" Article.
a. Preformed Pipe Insulation: ASJ.

N. Polyisocyanurate: Unfaced, preformed, rigid cellular polyisocyanurate material intended for use as thermal insulation.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Dow Chemical Company (The); Trymer 2000 XP.
b. Duna USA Inc.; Corafoam.
c. Dyplast Products; ISO-25.
d. Elliott Company of Indianapolis; Elfoam.
2. Comply with ASTM C 591, Type I or Type IV, except thermal conductivity (k-value) shall not exceed 0.19 Btu x in./h x sq. ft. x deg F (0.027 W/m x K) at 75 deg F (24 deg C) after 180 days of aging.
3. Flame-spread index shall be 25 or less, and smoke-developed index shall be 50 or less for thickness up to 1 inch (25 mm) as tested by ASTM E 84.
4. Fabricate shapes according to ASTM C 450 and ASTM C 585.
5. Factory-Applied Jacket: Requirements are specified in "Factory-Applied Jackets" Article.
a. Pipe Applications: ASJ, ASJ-SSL, PVDC or PVDC-SSL.

O. 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.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Armacell LLC; Tubolit.
b. Nomaco Insulation; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.

P. 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.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
a. Dow Chemical Company (The); Styrofoam.

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. Ramco Insulation, Inc.; Super-Stik.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
   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. Ramco Insulation, Inc.; Thermokote V.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.
   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. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

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. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-97.
      b. Eagle Bridges - Marathon Industries; 290.
      c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-27.
      d. Mon-Eco Industries, Inc.; 22-30.
      e. Vimasco Corporation; 760.
   2. 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).
   3. 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. 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. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84.
   2. 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).

3. 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. 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. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-96.
      b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-33.
   2. 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).
   3. 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. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Aeroflex USA, Inc.; Aeroseal.
      b. Armacell LLC; Armaflex 520 Adhesive.
      c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
      d. K-Flex USA; R-373 Contact Adhesive.
   2. 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).
   3. 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. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
      b. Eagle Bridges - Marathon Industries; 225.
      c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
      d. Mon-Eco Industries, Inc.; 22-25.
   2. 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).
   3. 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."

G. Polystyrene Adhesive: Solvent- or water-based, synthetic resin adhesive with a service temperature range of minus 20 to plus 140 deg F (29 to plus 60 deg C).
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-96.
      b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60.

H. 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, provide one of the following:
a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
b. Eagle Bridges - Marathon Industries; 225.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
Mon-Eco Industries, Inc.; 22-25.
2. 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).
3. 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."

I. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Dow Corning Corporation; 739, Dow Silicone.
b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
c. P.I.C. Plastics, Inc.; Welding Adhesive.
d. Speedline Corporation; Polyco VP Adhesive.
2. 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).
3. 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. Products: Subject to compliance with requirements, provide one of the following:
a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
b. Vimasco Corporation; 749.
2. 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.
3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.

b. Eagle Bridges - Marathon Industries; 501.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
d. Mon-Eco Industries, Inc.; 55-10.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.03 metric perm) at 35-mil (0.9-mm) dry film thickness.
3. Service Temperature Range: 0 to 180 deg F (Minus 18 to plus 82 deg C).
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
b. Eagle Bridges - Marathon Industries; 570.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.
2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
b. Eagle Bridges - Marathon Industries; 550.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
d. Mon-Eco Industries, Inc.; 55-50.
e. Vimasco Corporation; WC-1/WC-5.
2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

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. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
c. Vimasco Corporation; 713 and 714.

3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
4. Service Temperature Range: 0 to plus 180 deg F (Minus 18 to plus 82 deg C).
5. Color: White.

2.6 SEALANTS

A. Joint Sealants:
1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products: Subject to compliance with requirements, provide one of 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. Joint Sealants for Polystyrene Products: Subject to compliance with requirements, provide one of the following:
   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-70.
   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.
3. Materials shall be compatible with insulation materials, jackets, and substrates.
4. Permanently flexible, elastomeric sealant.
5. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).
6. Color: White or gray.
7. 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).
8. 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. Products: Subject to compliance with requirements, provide one of 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; 95-44.
   d. Mon-Eco Industries, Inc.; 44-05.
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, 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."

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 Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 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, 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."

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. 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 and PVDC-SSL jackets in subparagraphs below are proprietary products offered by Dow Chemical under the product names "Saran 540 Vapor Retarder Film" and "Saran 560 Vapor Retarder Film."
6. 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.
   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

7. 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.
   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
8. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
9. 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.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. (68 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm) for covering pipe and pipe fittings.
   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 Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas Number 10.

B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. (34 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm), in a Leno weave, for pipe.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.
      b. Vimasco Corporation; Elastafab 894.

2.9 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd. (271 g/sq. m).
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

2.10 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Johns Manville; Zeston.
      b. P.I.C. Plastics, Inc.; FG Series.
      c. Proto Corporation; LoSmoke.
      d. Speedline Corporation; SmokeSafe.
   2. Adhesive: As recommended by jacket material manufacturer.
   3. Color: Color-code jackets based on system. Color as selected by Architect.
   4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
      a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

D. Metal Jacket:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
      b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
      c. RPR Products, Inc.; Insul-Mate.
   2. 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 or factory cut and rolled to size.
      b. Finish and thickness are indicated in field-applied jacket schedules.
      c. Moisture Barrier for Indoor Applications: 2.5-mil- (0.063-mm-) thick polysurlyn.
      d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
      e. Factory-Fabricated Fitting Covers:
         1) Same material, finish, and thickness as jacket.
         2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
         3) 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.
   3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
      a. Sheet and roll stock ready for shop or field sizing or factory cut and rolled to size.
      b. Material, finish, and thickness are indicated in field-applied jacket schedules.
      c. Moisture Barrier for Indoor Applications: 2.5-mil- (0.063-mm-) thick polysurlyn.
      d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.

e. Factory-Fabricated Fitting Covers:
   1) Same material, finish, and thickness as jacket.
   2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
   3) 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. Underground Direct-Buried Jacket: 125-mil- (3.2-mm-) thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Pittsburgh Corning Corporation; Pittwrap.
      b. Polyguard Products, Inc.; Insulrap No Torch 125.

F. 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 crosslaminated polyethylene film covered with white or stucco-embossed aluminum-foil facing.
   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. Polyguard Products, Inc.; Alumaguard 60.

G. PVDC Jacket for Indoor Applications: 4-mil- (0.10-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms (0.013 metric perms) 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.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Dow Chemical Company (The); Saran 540 Vapor Retarder Film.

H. PVDC Jacket for Outdoor Applications: 6-mil- (0.15-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms (0.007 metric perms) 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.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Dow Chemical Company (The); Saran 560 Vapor Retarder Film.

I. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

2.11 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. ABI, Ideal Tape Division; 428 AWF ASJ.
      b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
      c. Compac Corporation; 104 and 105.
      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.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. ABI, Ideal Tape Division; 491 AWF FSK.
      b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
      c. Compac Corporation; 110 and 111.
      d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
   2. Width: 3 inches (75 mm).
   3. Thickness: 6.5 mils (0.16 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. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. ABI, Ideal Tape Division; 370 White PVC tape.
      b. Compac Corporation; 130.
      c. Venture Tape; 1506 CW NS.
   2. Width: 2 inches (50 mm).
   3. Thickness: 6 mils (0.15 mm).
   4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
   5. Elongation: 500 percent.
   6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. ABI, Ideal Tape Division; 488 AWF.
      b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
      c. Compac Corporation; 120.
      d. Venture Tape; 3520 CW.
   2. Width: 2 inches (50 mm).
   3. Thickness: 3.7 mils (0.093 mm).
   4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.

5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

E. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.
2. Width: 3 inches (75 mm).
3. Film Thickness: 4 mils (0.10 mm).
4. Adhesive Thickness: 1.5 mils (0.04 mm).
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch (10.1 N/mm) in width.

F. PVDC Tape for Outdoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
a. Dow Chemical Company (The); Saran 560 Vapor Retarder Tape.
2. Width: 3 inches (75 mm).
3. Film Thickness: 6 mils (0.15 mm).
4. Adhesive Thickness: 1.5 mils (0.04 mm).
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch (10.1 N/mm) in width.

2.12 SECUREMENTS

A. Bands:
1. Products: Subject to compliance with requirements, provide one of the following:
a. ITW Insulation Systems; Gerrard Strapping and Seals.
b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch (0.38 mm) thick, 3/4 inch (19 mm) wide with wing seal or closed seal.
3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 3/4 inch (19 mm) wide with wing seal or closed seal.
4. 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. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

C. Wire: 0.080-inch (2.0-mm) nickel-copper alloy, 0.062-inch (1.6-mm) soft-annealed, stainless steel or 0.062-inch (1.6-mm) soft-annealed, galvanized steel.
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. C & F Wire.

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 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 closes 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 CALCIUM SILICATE INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
1. Secure single-layer insulation with stainless-steel bands at 12-inch (300-mm) intervals and tighten bands without deforming insulation materials.
2. Install two-layer insulation with joints tightly butted and staggered at least 3 inches (75 mm). Secure inner layer with wire spaced at 12-inch (300-mm) intervals. Secure outer layer with stainless-steel bands at 12-inch (300-mm) intervals.
3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch (25 mm). Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.

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 block insulation of same material and thickness as pipe insulation.
4. Finish flange insulation same as pipe insulation.

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 insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with wire or bands.
3. Finish fittings insulation same as pipe insulation.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
2. Install insulation to flanges as specified for flange insulation application.
3. Finish valve and specialty insulation same as pipe insulation.

3.7 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.

3.8 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.

3.9 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.

3.10 INSTALLATION OF PHENOLIC INSULATION

A. General Installation Requirements:
1. Secure single-layer insulation with stainless-steel bands at 12-inch (300-mm) intervals and tighten bands without deforming insulation materials.
2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches (75 mm). Secure inner layer with 0.062-inch (1.6-mm) wire spaced at 12-inch (300-mm) intervals. Secure outer layer with stainless-steel bands at 12-inch (300-mm) intervals.

B. 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 with vapor retarders 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.

C. 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 block insulation of same material and thickness as pipe insulation.

D. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

E. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
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.

3.11 INSTALLATION OF POLYISOCYANURATE INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of insulation to pipe with tape or bands and tighten without deforming insulation materials. Orient longitudinal joints between half sections in 3- and 9-o'clock positions on the pipe.
2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.

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, same thickness of adjacent pipe insulation, not to exceed 1-1/2-inch (38-mm) thickness.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyisocyanurate block insulation of same thickness as pipe insulation.

C. Insulation Installation on Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of polyisocyanurate 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.

3.12 INSTALLATION OF POLYOLEFIN INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube 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 polyolefin 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 polyolefin 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 cut sections of polyolefin pipe and sheet 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.
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.

3.13 INSTALLATION OF POLYSTYRENE INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of insulation with tape or bands and tighten bands without deforming insulation materials. Orient longitudinal joints between half sections in 3- and 9-o'clock positions on the pipe.
2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.

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, and make thickness same as adjacent pipe insulation, not to exceed 1-1/2-inch (38-mm).

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polystyrene block insulation of same thickness as pipe insulation.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed section of polystyrene 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.

3.14 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. 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-presized jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized 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 "fishmouthing," 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.

3.15 FINISHES

A. Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
   1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
      a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.16 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 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.

3.17 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.

3.18 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. Cellular Glass: 1-1/2 inches (38 mm) thick.
b. Flexible Elastomeric: 1 inch (25 mm) thick.
c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
d. Phenolic: 1 inch (25 mm) thick.
e. Polyisocyanurate: 1 inch (25 mm) thick.
f. Polyolefin: 1 inch (25 mm) thick.

B. Refrigerant Suction and Hot-Gas Piping:
1. All Pipe Sizes: Insulation shall be one of the following:
a. Cellular Glass: 1-1/2 inches (38 mm) thick.
b. Flexible Elastomeric: 1 inch (25 mm) thick.
c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
d. Phenolic: 1 inch (25 mm) thick.
e. Polyisocyanurate: 1 inch (25 mm) thick.
f. Polyolefin: 1 inch (25 mm) thick.

C. Refrigerant Suction and Hot-Gas Flexible Tubing:
1. All Pipe Sizes: Insulation shall be one of the following:
a. Flexible Elastomeric: 1 inch (25 mm) thick.
b. Polyolefin: 1 inch (25 mm) thick.

3.19 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Refrigerant Suction and Hot-Gas Piping:
1. All Pipe Sizes: Insulation shall be one of the following:
a. Cellular Glass: 2 inches (50 mm) thick.
b. Flexible Elastomeric: 2 inches (50 mm) thick.
c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches (50 mm) thick.
d. Phenolic: 2 inches (50 mm) thick.
e. Polyisocyanurate: 2 inches (50 mm) thick.
f. Polyolefin: 2 inches (50 mm) thick.

g. Polystyrene: 2 inches (50 mm) thick.

B. Refrigerant Suction and Hot-Gas Flexible Tubing:
1. All Pipe Sizes: Insulation shall be one of the following:
a. Flexible Elastomeric: 2 inches (50 mm) thick.
b. Polyolefin: 2 inches (50 mm) thick.

3.20 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.
2. PVC, Color-Coded by System: 30 mils (0.8 mm) thick.
3. Aluminum, Smooth, Corrugated or Stucco Embossed: 0.032 inch (0.81 mm) thick.
4. Painted Aluminum, Smooth, Corrugated or Stucco Embossed: 0.032 inch (0.81 mm) thick.
5. Stainless Steel, Type 304, or Type 316, Smooth 2B Finish, Corrugated or Stucco Embossed: 0.024 inch (0.61 mm) thick.

D. Piping, Exposed:
1. Retain one of six subparagraphs below.
2. PVC, Color-Coded by System: 30 mils (0.8 mm) thick.
3. Aluminum, Smooth, Corrugated or Stucco Embossed: 0.040 inch (1.0 mm) thick.
4. Painted Aluminum, Smooth, Corrugated or Stucco Embossed: 0.032 inch (0.81 mm) thick.
5. Stainless Steel, Type 304, or Type 316, Smooth 2B Finish, Corrugated or Stucco Embossed: 0.024 inch (0.61 mm) thick.

3.21 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, Concealed:
1. PVC, Color-Coded by System: 30 mils (0.8 mm) thick.
2. Aluminum, Smooth, Corrugated or Stucco Embossed: 0.040 inch (1.0 mm) thick.
3. Painted Aluminum, Smooth, Corrugated or Stucco Embossed: 0.032 inch (0.81 mm) thick.
4. Stainless Steel, Type 304, 316, 304 or 316, Smooth 2B Finish, Corrugated or Stucco Embossed: 0.024 inch (0.61 mm) thick.

D. Piping, Exposed:
1. PVC: 40 mils (1.0 mm) thick.

2. Painted Aluminum, Smooth, Corrugated, Stucco Embossed or with Z-Shaped Locking Seam: 0.040 inch (1.0 mm) thick.
3. Stainless Steel, Type 304, 316, 304 or 316, Smooth 2B Finish, Corrugated, Stucco Embossed or with Z-Shaped Locking Seam: 0.024 inch (0.61 mm) thick.

END OF SECTION

SECTION 230923 – DIRECT DIGITAL CONTROL (DDC) SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Building Management System (BMS), utilizing direct digital controls.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Products Supplied but Not Installed Under This Section:
   1. Control valves.

B. Products Installed but Not Supplied Under This Section:
   1. None.

C. Products Not Furnished or Installed but Integrated with the Work of This Section:
   1. In-line meters (gas, water, power).
   2. Refrigerant monitors.
   3. Smoke detectors (through alarm relay contacts).

D. Work Required Under Other Divisions Related to This Section:
   1. Power wiring to line side of motor starters, disconnects or variable frequency drives.
   2. Provision and wiring of smoke detectors and other devices relating to fire alarm system.
   3. Campus LAN (Ethernet) connection adjacent to JACE network management controller.

1.3 SYSTEM DESCRIPTION

A. Scope: Furnish all labor, materials, and equipment necessary for a complete and operating Building Management System (BMS), utilizing Direct Digital Controls as shown on the drawings and as described herein. Drawings are diagrammatic only. All controllers furnished in this section shall communicate on a peer-to-peer bus over an open protocol bus (Examples: LonTalk, BACnet, MODBUS) or IP Network.
   1. The intent of this specification is to provide a system that is consistent with BMS systems throughout the owner's facilities running the Niagara 4 Framework.
   2. System architecture shall fully support a multi-vendor environment and be able to integrate third party systems via existing vendor protocols including, as a minimum, LonTalk, BACnet and MODBUS.
   3. System architecture shall provide secure Web access using any of the current versions of Microsoft Internet Explorer, Mozilla Firefox, or Google Chrome browsers from any computer on the owner's LAN.
   4. All control devices furnished with this Section shall be programmable directly from the Niagara 4 Workbench embedded toolset upon completion of this project. The use of configurable or programmable controllers that require additional

software tools for post-installation maintenance shall not be acceptable.

5. Any control vendor that shall provide additional BMS server software shall be unacceptable. Only systems that utilize the Niagara 4 Framework shall satisfy the requirements of this section.
6. The BMS server shall host all graphic files for the control system. All graphics and navigation schemes for this project shall match those that are on the existing campus NiagaraAX or Niagara 4 Framework server.
7. A laptop computer including engineering/programming software to modify Operating System Server BMS programs and graphics is optional if all engineering/programming software tools and backups are embedded in the system.
8. Owner shall receive all Administrator level login and passwords for engineering toolset at first training session. The Owner shall have full licensing and full access rights for all network management, operating system server, engineering and programming software required for the ongoing maintenance and operation of the BMS.
9. OPEN NIC STATEMENTS - All Niagara 4 software licenses shall have the following NiCS: "accept.station.in=*"; "accept.station.out=*"and "accept.wb.in=*"and "accept.wb.out=*". All open NIC statements shall follow Niagara Open NIC specifications.
10. All JACE hardware licenses and certificates shall be stored on local MicroSD memory card employing encrypted "safe boot" technology.
11. To ensure quality, any JACE 8000 hardware products used on this project shall come through the Tridium Richmond VA shipping facility. JACE hardware products not meeting this requirement will not be allowed.

B. All products of the BMS shall be provided with the following agency approvals. Verification that the approvals exist for all submitted products shall be provided on request, with the submittal package. Systems or products not currently offering the following approvals are not acceptable.

1. FIPS 140-2 Level 1 Conformance (Federal Information Processing Standard).
2. Federal Communications Commission (FCC), Rules and Regulations, Volume II - July 1986 Part 15 Class A Radio Frequency Devices.
3. FCC, Part 15, Subpart B, Class B.
4. FCC, Part 15, Subpart C.
5. FCC, Part 15, Subpart J, Class A Computing Devices.
6. UL 504 - Industrial Control Equipment.
7. UL 506 - Specialty Transformers.
8. UL 910 - Test Method for Fire and Smoke Characteristics of Electrical and Optical-Fiber Cables Used in Air-Handling Spaces.
9. UL 916 - Energy Management Systems All.
10. UL 1449 - Transient Voltage Suppression.
11. Standard Test for Flame Propagation Height of Electrical and Optical - Fiber Cables Installed Vertically in Shafts.
12. EIA/ANSI 232-E - Interface Between Data Technical Equipment and Data Circuit Terminal Equipment Employing Serial Binary Data Interchange.
13. EIA 455 - Standard Test Procedures for Fiber Optic Fibers, Cables, Transducers, Connecting and Terminating Devices.
14. IEEE C62.41- Surge Voltages in Low-Voltage AC Power Circuits.
15. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.

a. NEMA 250 - Enclosures for Electrical Equipment.
16. NEMA ICS 1 - Industrial Controls and Systems.
17. NEMA ST 1 - Specialty Transformers.
18. NCSBC Compliance, Energy: Performance of control system shall meet or surpass the requirements of ASHRAE/IESNA 90.1-1999.
19. CE 61326.
20. C-Tick.
21. cUL.

1.4 SPECIFICATION NOMENCLATURE

A. Acronyms used in this specification are as follows:
1. Actuator: Control device that opens or closes valve or damper in response to control signal.
2. AI: Analog Input.
3. AO: Analog Output.
4. Analog: Continuously variable state over stated range of values.
5. AUC: Advanced Unitary Controller.
6. BCT: BACnet Touchscreen Communicating Thermostat.
7. BMS: Building Management System.
8. DDC: Direct Digital Control.
9. Discrete: Binary or digital state.
10. DI: Discrete Input.
11. DO: Discrete Output.
12. FC: Fail Closed position of control device or actuator. Device moves to closed position on loss of control signal or energy source.
13. FO: Fail open (position of control device or actuator). Device moves to open position on loss of control signal or energy source.
14. GUI: Graphical User Interface.
15. HMI: Human Machine Interface.
16. HVAC: Heating, Ventilating and Air Conditioning.
17. IDC: Interoperable Digital Controller.
18. ILC: Interoperable Lon Controller.
19. LAN: Local Area Network.
20. Modulating: Movement of a control device through an entire range of values, proportional to an infinitely variable input value.
21. Motorized: Control device with actuator.
22. NAC: Network Area Controller.
23. NC: Normally closed position of switch after control signal is removed or normally closed position of manually operated valves or dampers.
24. NO: Normally open position of switch after control signal is removed; or the open position of a controlled valve or damper after the control signal is removed; or the usual position of a manually operated valve.
25. OSS: Operating System Server, host for system graphics, alarms, trends, etc.
26. Operator: Same as actuator.
27. PC: Personal Computer.
28. Peer-to-Peer: Mode of communication between controllers in which each device connected to network has equal status and each shares its database values with all other devices connected to network.
29. P: Proportional control; control mode with continuous linear relationship between

observed input signal and final controlled output element.

30. PI: Proportional-Integral control, control mode with continuous proportional output plus additional change in output based on both amount and duration of change in controller variable (reset control).
31. PICS: BACnet Product Interoperability Compliance Statement.
32. PICU: Programmable IP Control Unit.
33. PID: Proportional-Integral-Derivative control, control mode with continuous correction of final controller output element versus input signal based on proportional error, its time history (reset) and rate at which it is changing (derivative).
34. Point: Analog or discrete instrument with addressable database value.
35. PPCU: Programmable Plant Control Unit.
36. UICU: Unitary IP Control Unit.
37. WAN: Wide Area Network.

1.5 SUBMITTALS

A. Submit under provisions of Section 013300 “Submittal Procedures.”

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

C. Submit documentation of contractor qualifications, including those indicated in "Quality Assurance" if requested by the A-E.

D. Five copies of shop drawings of the entire control system shall be submitted and shall consist of a complete list of equipment and materials, including manufacturers' catalog data sheets and installation instructions. Submit in printed electronic format. Samples of written Controller Checkout Sheets and Performance Verification Procedures for applications similar in scope shall be included for approval.

E. Shop drawings shall also contain complete wiring and schematic diagrams, sequences of operation, control system bus layout and any other details required to demonstrate that the system has been coordinated and will properly function as a system. Terminal identification for all control wiring shall be shown on the shop drawings.

F. Upon completion of the work, provide a electronic set of ' as-built' drawings and other project-specific documentation and install onto WEB’s Supervisor operator workstation.

G. Any deviations from these specifications or the work indicated on the drawings shall be clearly identified in the Submittals.

1.6 QUALITY ASSURANCE

A. The Control System Contractor shall have a full service DDC office within 140 miles of the job site. The office shall be staffed with applications engineers, software engineers and field technicians. This office shall maintain parts inventory and shall have all testing and diagnostic equipment necessary to support this work, as well as staff trained in the

use of this equipment.

B. Single Source Responsibility of Supplier: The Control System Contractor shall be responsible for the complete installation and proper operation of the control system. The Control System Contractor shall exclusively be in the regular and customary business of design, installation, and service of computerized building management systems similar in size and complexity to the system specified. The Control System Contractor shall be the manufacturer of the primary DDC system components or shall have been the authorized representative for the primary DDC components manufacturer for at least 10 years. All control panels shall be assembled by the Control System Contractor in a UL-Certified 508A panel shop.

C. Equipment and Materials: Equipment and materials shall be cataloged products of manufacturers regularly engaged in the production and installation of HVAC control systems. Products shall be manufacturer's latest standard design and have been tested and proven in actual use.

1.7 PRE-INSTALLATION MEETINGS

A. Convene minimum two weeks prior to starting work of this section.

1.8 DELIVERY, STORAGE AND HANDLING

A. Maintain integrity of shipping cartons for each piece of equipment and control device through shipping, storage and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.

1.9 JOB CONDITIONS

A. Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to ensure that the Work will be carried out in an orderly fashion. It shall be this Contractor's responsibility to check the Contract Documents for possible conflicts between his Work and that of other crafts in equipment location, pipe, duct, and conduit runs, electrical outlets and fixtures, air diffusers and structural and architectural features.

1.10 SEQUENCING

A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design:

1. Distech Controls (Tridium Niagra 4).
2. Automated Logic Controls.
3. Honeywell (Tridium Niagra 4).
4. Or approved equal.

2.2 GENERAL

A. The Building Management System (BMS) shall be comprised of a network of interoperable, stand-alone digital controllers, a network area controller, graphics and programming and other control devices for a complete system as specified herein.

B. The installed system shall provide secure password access to all features, functions and data contained in the overall BMS.

2.3 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURE

A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system utilizing Open protocols in one open, interoperable system including Analytics for BMS fault detection and diagnostics, including sub-system alarm suppression as described in ASHRAE Guideline 36-2018.

B. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. Physical connection of any BACnet control equipment, such as chillers, shall be via Ethernet or IP.

C. All components and controllers supplied under this contract shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data shall not be acceptable.

D. The supplied system shall incorporate the ability to access all data using HTML5 enabled browsers without requiring proprietary operator interface and configuration programs or browser plug-ins. An Open Database Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on the Operating System Server located in the Facilities Office on the LAN. Systems requiring proprietary database and user interface programs shall not be acceptable.

E. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. Systems employing a "flat" single tiered architecture shall not be acceptable.
   1. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.
   2. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

2.4 BAS SERVER HARDWARE

A. Minimum Computer Configuration (Hardware Independent). GUHSD existing.
   1. Central Server: Owner shall provide a dedicated BAS virtual server or a PC server with configuration that includes the following components as a minimum.
   2. Processor: Intel Xeon CPU E5-2640 x64 (or better), compatible with dual- and quad-core processors.
   3. Memory: 2 GB or more recommended for large systems, 8 GB or more recommended for the Windows 64-bit version.
   4. Hard Drive: 256 GB minimum, more recommended depending on archiving requirements.
   5. Display: Video card and monitor capable of displaying 1024 x 768 pixel resolution or greater.
   6. Network Support: Ethernet adapter (10/100 Mb with RJ-45 connector).
   7. Connectivity: Full-time high-speed ISP connection recommended for remote site access (i.e., T1, ADSL, cable modem).

B. Standard Client: The thin-client Web Browser BAS GUI shall be Microsoft Internet Explorer (10.0 or later) running on Microsoft 7+. No special software shall be required to be installed on the PCs used to access the BAS via a web browser.

2.5 SYSTEM NETWORK CONTROLLER (SNC)

A. These controllers are designed to manage communications between the Programmable IP Control Units (PICU), Programmable Plant Control Units (PPCU), Unitary IP Control Unit (UICU), Advanced Unitary Controllers (AUC), and BACnet Touchscreen Communication Thermostats (BCT) which are connected to its communications trunks or directly on the IP network, manage communications between itself and other system network controllers (SNC), PICUs, PPCUs, UICUs, and with any operator workstations (OWS) that are part of the BAS, and perform control and operating strategies for the system based on information from any controller connected to the BAS.

B. The controllers shall be fully programmable to meet the unique requirements of the facility it shall control, including Analytic calculations.

C. The controllers shall be capable of peer-to-peer communications with other SNC's, PICUs, PPCUs, UICUs, and with any OWS connected to the BAS, whether the OWS is directly connected, connected via cellular modem, or connected via the Internet.

D. The communication protocols utilized for peer-to-peer communications between SNC's will be Niagara 4 FoxS, BACnet TCP/IP and SNMP. Use of a proprietary communication protocol for peer-to-peer communications between SNC's is not allowed.

E. The SNC shall employ a device count capacity license model that supports expansion capabilities.

F. The SNC shall be enabled to support and shall be licensed with the following Open protocol drivers (client and server) by default:
   1. BACnet.
   2. Lon.
   3. MODBUS.
   4. SNMP.

5. KNX.

G. The SNC shall be capable of executing application control programs to provide:
   1. Calendar functions.
   2. Scheduling.
   3. Trending.
   4. Alarm monitoring and routing.
   5. Time synchronization.
   6. Integration of LonWorks, BACnet, and MODBUS controller data.
   7. Network management functions for all SNC, PICU, PPCU, UICU, AUC and BCT based devices.
   8. Analytics for BMS fault detection and diagnostics, including sub-system alarm suppression as described in ASHRAE Guideline 36-2018.
   9. 25 Niagara N4 Analytic Points.

H. The SNC shall provide the following hardware features as a minimum:
   1. Two 10/100 Mbps Ethernet ports.
   2. Two Isolated RS-485 ports with biasing switches.
   3. 1 GB RAM.
   4. 4 GB Flash Total Storage / 2 GB User Storage.
   5. Wi-Fi (Client or WAP).
   6. USB Flash Drive.
   7. High Speed Field Bus Expansion.
   8. -20-60 degrees C Ambient Operating Temperature.
   9. Integrated 24 VAC/DC Global Power Supply.
   10. MicroSD Memory Card Employing Encrypted Safe Boot Technology.

I. The SNC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 16 simultaneous users.

J. The SNC shall provide alarm recognition, storage, routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.

K. The SNC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via cellular modem, or wide-area network.
   1. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but not limited to:
      a. Alarm.
      b. Return to normal.
      c. To default.
   2. Alarms shall be annunciated in any of the following manners as defined by the user:
      a. Screen message text.
      b. Email of complete alarm message to multiple recipients.
      c. Pagers via paging services that initiate a page on receipt of email message.
      d. Graphics with flashing alarm object(s).
   3. The following shall be recorded by the SNC for each alarm (at a minimum):
      a. Time and date.
      b. Equipment (air handler #, access way, etc.).

c. Acknowledge time, date, and user who issued acknowledgement.

L. Programming software and all controller "Setup Wizards" shall be embedded into the SNC.

M. The SNC shall support the following security functions.
1. Module code signing to verify the author of programming tool and confirm that the code has not been altered or corrupted.
2. Role-Based Access Control (RBAC) for managing user roles and permissions.
3. Require users to use strong credentials.
4. Data in Motion and Sensitive Data at Rest be encrypted.
5. LDAP and Kerberos integration of access management.

N. The SNC shall support the following data modeling structures to utilize Search; Hierarchy; Template; and Permission functionality:
1. Metadata: Descriptive tags to define the structure of properties.
2. Tagging: Process to apply metadata to components
3. Tag Dictionary

O. The SNC shall employ template functionality. Templates are a containerized set of configured data tags, graphics, histories, alarms... that are set to be deployed as a unit based upon manufacturer's controller and relationships. All lower level communicating controllers (PICU, PPCU, UICU, AUC) shall have an associated template file for reuse on future project additions.

P. The SNC shall be provided with a Five-Year Software Maintenance license. Labor to implement not included.

2.6 PROGRAMMABLE IP CONTROL UNIT (PICU)

A. HVAC PICU controllers shall be fully programmable to meet the unique requirements of the facility it shall control. The controller platform shall provide options and advanced system functions, programmable and configurable using Niagara 4 Framework, that allow standard and customizable control solutions required in executing the "Sequence of Operation". PICU shall be BACnet BTL; AWS/C, WSP listed. PICU shall meet the BACnet Building Controller (B-BC) Profile.

B. All PICUs shall be application programmable and shall always maintain their certification. All control sequences within or programmed into the PICU shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained.

C. The controllers shall be capable of daisy-chain IP communications with other PICU’s and peer-to-peer communications with SNC's and with any OWS connected to the BAS, whether the OWS is directly connected, connected via cellular modem, or connected via the Internet.
1. Daisy Chain IP connectivity Integrated Fail-safe utilizing Rapid Spanning Tree Protocol 802.1w.

D. The communication protocols utilized for peer-to-peer communications between PICU's will be Niagara 4 FoxS or BACnet TCP/IP. Use of a proprietary communication protocol

for peer-to-peer communications between PICU's is not allowed.

E. The PICU shall be licensed and enabled to support three (3) devices and shall be licensed with the following Open protocol drivers by default:
   1. BACnet IP
   2. Modbus TCP

F. The PICU shall be provided with Lifetime Software Maintenance license. Labor to implement not included.

G. The PICU shall be capable of executing application control programs to provide:
   1. Calendar functions.
   2. Scheduling.
   3. Trending.
   4. Alarm monitoring and routing.
   5. Time synchronization.
   6. Integration of all daisy-chain PICU's.
   7. Network management functions for all daisy-chain PICU's.
   8. Analytics for BMS fault detection and diagnostics, including sub-system alarm suppression as described in ASHRAE Guideline 36-2018.
   9. 10 Niagara N4 Analytic Points.

H. Programming software shall be embedded into the PICU. The PICU shall not require any external configuration tool or programming tool. All configuration and programming tasks shall be accomplished and accessible from within the embedded Niagara 4 environment.

I. The PICU shall support the following security functions.
   1. Module code signing to verify the author of programming tool and confirm that the code has not been altered or corrupted.
   2. Role-Based Access Control (RBAC) for managing user roles and permissions.
   3. Require users to use strong credentials.
   4. Data in Motion and Sensitive Data at Rest be encrypted.
   5. Encrypted (PKI) Secure IP Stack Communication Security.
   6. FIPS 140-2 Level 1 Cryptographic Module Compliant.

J. The minimum controller Environmental ratings.
   1. Operating Temperature Ambient Rating: -4 degrees to 131 degrees F (-20 degrees to 55 degrees C).
   2. Storage Temperature Ambient Rating: -4 degrees to 150 degrees F (-20 degrees to 65 degrees C).
   3. Relative Humidity: 5% to 95% non-condensing.

K. The controller shall have the additional approval requirements, listings, and approvals:
   1. UL 60730-1.
   2. Meets FCC Part 15, Subpart B, Class B (radiated emissions) requirements.
   3. Conforms requirements European Consortium standard EN 61000-6-1; 2001 (EU Immunity).
   4. Conforms requirements European Consortium standard EN 61000-6-3; 2001 (EU Emission).
   5. The controller housing shall be UL plenum rated mounting to either a panel or DIN

rail (2.3" x 5.3" x 4.3;" 57.4mm x 135mm x 110mm).

L. The PICU shall provide the following hardware features as a minimum:
1. The PICU shall provide LED indication of Power, Fault, Ethernet TX/RX/Traffic/Speed without cover removal.
2. Four 10/100/1000 Mbps Ethernet unmanaged switch, RJ-45 ports.
3. ARM 9 32-bit processor, 800 MHz.
4. 1 GB RAM.
5. 512 KB MRAM.
6. 2 GB Flash Memory.
7. The PICU shall have two microprocessors. The Host processor contains on-chip FLASH program memory, FLASH information memory, and RAM to run the main HVAC application. The second processor for network communications.
8. One USB 2.0 port.
9. 2.0 A fast-acting Overcurrent Protection.
10. Integrated 20-30 VAC Global Power Supply.
11. Real Time Clock, 24 hour, 365 day, multi-year calendar +/- 1 minute per month at 77F (25C).
12. RTC Power Failure Backup, 24 hours at 32 degrees to 100 degrees F (0 degrees to 38 degrees C) .
13. Power Output: 20 VDC +/- 10% at 7 mA maximum.
14. AC power consumption at 9VA, max 100VA.
15. Removable Terminal Blocks.
16. Sensor, Actuator, and I/O Module Expandability via a 2-wire, polarity insensitive local PICU communication bus.
17. 150 Point Base License.
18. LED for each hardware I/O point.
19. Output H-O-A Switches.
20. VAV PICU shall include an internal differential pressure sensor.
    a. Operating Range: 0 to 2 inch WC (0 to 374 Pa).
    b. Accuracy: +/- 2% of full scale at 32 degrees to 122 degrees F (0 degrees to 50 degrees C).

M. The PICU shall support standard Web browser access via the Intranet/Internet.

N. The PICU shall be able to route any alarm condition to any defined user location whether connected to a local network or wide-area network.
1. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but not limited to:
    a. Alarm.
    b. Return to normal.
    c. To default.
2. Alarms shall be annunciated in any of the following manners as defined by the user:
    a. Screen message text.
    b. Email of complete alarm message to multiple recipients.
    c. Pagers via paging services that initiate a page on receipt of email message.
    d. Graphics with flashing alarm object(s).
3. The following shall be recorded by the PICU for each alarm (at a minimum):
    a. Time and date.

b. Equipment (air handler #, access way, etc.).
c. Acknowledge time, date, and user who issued acknowledgement.

O. PICU Controllers shall support at minimum the following control techniques:
1. General-purpose control loops that can incorporate Demand Limit Control strategies, Set point reset, adaptive intelligent recovery, and time of day bypass.
2. General-purpose, non-linear control loops.
3. Start/stop Loops.
4. If/Then/Else logic loops.
5. Math Function loops (MIN, MAX, AVG, SUM, SUB, SQRT, MUL, DIV, ENTHALPY).

P. The following six integral Universal Inputs/Outputs shall be supported per each PICU:
1. UI/O as Analog Inputs; 16 Bit resolution (Thermistor or RTD configurable from 100 to 100K Ohm, 0-10 VDC, 4-20 mA).
2. UI/O as Digital Inputs; Dry Contact / Totalizer.
a. Dry Contact to detect Open / Closed Circuit (Voltage Rating; 0-30 VDC Open Circuit: Resistance Rating; Open Circuit 3,000 Ohms, Closed Circuit 500 Ohms).
b. Totalizer – Dry Contact (100 Hz, 360,000 pulses per hour maximum frequency: Minimum Duty Cycle 5 ms ON / 5 ms OFF).
3. UI/O as Analog Outputs 3 UI/O can be configured as AO)
a. 0-10.0 Vdc, 10.0mA maximum.
b. 0-20.0 mA, 550 Ohms maximum.
4. LED for each hardware I/O point.

Q. The following six (6) integral Digital Outputs (Triac) shall be supported per each PICU:
1. Solid State Relay normally open contacts, 20-30 VAC @ 50/60 Hz, at 1.0 A Continuous, 3.5 A Inrush.
2. LED for each hardware I/O point.
3. Output H-O-A Switches.

R. The PICU shall employ a 150 Point Base License device count capacity license model that supports I/O expansion capabilities.

S. Each PICU shall have expansion ability to support additional I/O requirements through the use of remote input/output modules and a local communication bus. Each Unitary PICU shall be able to support a maximum of 8 Expansion I/O Modules for a maximum of 150 physical I/O points.
1. Mixed Expansion I/O Modules (UI/O & DO) shall communicate with PICU via a 2-wire bus and include removable terminals for field device wires.
2. Mixed Expansion I/O Modules shall be available in the following configurations:
a. 3 UI/O, 2 AO, and 2 DO (7 Points).
b. 14 UI/O (5 can be configured as AO), and 6 DO (20 Points).
3. Universal Inputs/Outputs shall be supported per each Expansion I/O Module:
a. UI/O as Analog Inputs; 16 Bit resolution (Thermistor or RTD configurable from 100 to 100K Ohm, 0-10 VDC, 4-20 mA).
b. UI/O as Digital Inputs; Dry Contact / Totalizer.
1) Dry Contact to detect Open / Closed Circuit (Voltage Rating; 0-30 VDC Open Circuit: Resistance Rating; Open Circuit 3,000 Ohms, Closed Circuit 500 Ohms).
2) Totalizer – Dry Contact (100 Hz, 360,000 pulses per hour maximum

frequency: Minimum Duty Cycle 5 ms ON / 5 ms OFF).

c. UI/O as Analog Outputs (UI/O can be configured as AO)
   1) 0-10.0 Vdc, 10.0mA maximum.
   2) 0-20.0 mA, 550 Ohms maximum.
d. LED for each hardware I/O point.

4. Digital Outputs (Triac) shall be supported per each Expansion I/O Module:
   a. Solid State Relay normally open contacts, 20-30 VAC @ 50/60 Hz, at 1.0 A Continuous, 3.5 A Inrush.
   b. LED for each hardware I/O point.
   c. Output H-O-A Switches.

T. The PICU shall not include an integrated Local Operator Interface but shall be capable of utilizing a standard browser-based device such as a Tablet, Touch Screen Device, etc.

2.7 PROGRAMMABLE PLANT CONTROL UNIT (PPCU)

A. HVAC PPCU controllers shall be fully programmable to meet the unique requirements of the facility it shall control. The controller platform shall provide options and advanced system functions, programmable and configurable using Niagara 4 Framework, that allow standard and customizable control solutions required in executing the "Sequence of Operation".

B. All PPCUs shall be application programmable and shall always maintain their certification. All control sequences within or programmed into the PPCU shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained.

C. The PPCUs shall be capable of daisy-chain IP communications with other PPCU's and peer-to-peer communications with SNC's and with any OWS connected to the BAS, whether the OWS is directly connected, connected via cellular modem, or connected via the Internet.

D. The communication protocols utilized for peer-to-peer communications between PPCU's will be Niagara 4 FoxS or BACnet TCP/IP. Use of a proprietary communication protocol for peer-to-peer communications between PPCU's is not allowed.

E. The PPCU shall be licensed and enabled to support four (4) devices, expandable to forty nine and shall be licensed with the following Open protocol drivers by default:
   1. BACnet (MS/TP and IP ISO 16484-5).
   2. LonTalk (ISO 14908).
   3. MODBUS (RTU and TCP).

F. The PPCU shall be provided with a Five Year Software Maintenance license. Labor to implement not included.

G. The PPCU shall provide LED indication of communication and controller performance to the technician, without cover removal.

H. The PPCU shall be capable of executing application control programs to provide:
   1. Calendar functions.

2. Scheduling.
3. Trending.
4. Alarm monitoring and routing.
5. Time synchronization.
6. Integration of all daisy-chain PPCU's.
7. Network management functions for all daisy-chain PPCU's.
8. Analytics for BMS fault detection and diagnostics, including sub-system alarm suppression as described in ASHRAE Guideline 36-2018.
9. 25 Niagara N4 Analytic Points (Expandable).

I. Programming software shall be embedded into the PPCU. The PPCU shall not require any external configuration tool or programming tool. All configuration and programming tasks shall be accomplished and accessible from within the embedded Niagara 4 environment.

J. The PPCU shall support the following security functions.
1. Module code signing to verify the author of programming tool and confirm that the code has not been altered or corrupted.
2. Role-Based Access Control (RBAC) for managing user roles and permissions.
3. Require users to use strong credentials.
4. Data in Motion and Sensitive Data at Rest be encrypted.

K. The PPCU shall provide the following hardware features as a minimum:
1. Two10/100 Mbps Ethernet ports.
2. Two RS-485 ports, one isolated and one non-isolated, with biasing switches.
3. ARM 9 32-bit processor, 1 GHz
4. 1 GB RAM
5. 512 KB MRAM
6. 4 GB Flash Memory
7. Two USB 2.0 ports
8. One HMI port to connect onboard or remote HMI.
9. 0-50 degrees C Ambient Operating Temperature
10. Integrated 24 VAC/DC Global Power Supply
11. Real Time Clock

L. The PPCU shall support standard Web browser access via the Intranet/Internet.

M. The PPCU shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via cellular modem, or wide-area network.
1. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but not limited to:
   a. Alarm.
   b. Return to normal.
   c. To default.
2. Alarms shall be annunciated in any of the following manners as defined by the user:
   a. Screen message text.
   b. Email of complete alarm message to multiple recipients.
   c. Pagers via paging services that initiate a page on receipt of email message.

d. Graphics with flashing alarm object(s).

3. The following shall be recorded by the PPCU for each alarm (at a minimum):
   a. Time and date.
   b. Equipment (air handler #, access way, etc.).
   c. Acknowledge time, date, and user who issued acknowledgement.

N. PPCU Controllers shall support at minimum the following control techniques:
1. General-purpose control loops that can incorporate Demand Limit Control strategies, Set point reset, adaptive intelligent recovery, and time of day bypass.
2. General-purpose, non-linear control loops.
3. Start/stop Loops.
4. If/Then/Else logic loops.
5. Math Function loops (MIN, MAX, AVG, SUM, SUB, SQRT, MUL, DIV, ENTHALPY).
6. Analytic calculations.

O. The following 26 integral Inputs/Outputs shall be supported per each PPCU:
1. Six integral 12 Bit resolution Universal Inputs (configurable as 20K NTC, 10K NTC, 0/2-10V, 0/4-20mA, 0.4Hz Dry Contact).
2. Four integral dry contact / totalizer Digital Inputs. Totalizer: 15Hz (25ms on, 25ms off, 5ms bounce).
3. Four integral 8 Bit 0-10 Vdc Analog Outputs with configurable safety position selections.
4. Eight integral Digital Outputs.
   a. Four Relay normally open contact at 3A, 250Vac, 30Vdc.
   b. One Relay normally open contact at 10A, 250Vac, 30Vdc with configurable safety position selections.
   c. Three Relay normally open contact with common feed at 3A, 250Vac, 30Vdc with configurable safety position selections.

P. The PPCU shall employ a device count capacity license model that supports I/O expansion capabilities.

Q. Each PPCU shall have expansion ability to support additional I/O requirements through the use of remote input/output modules and a local communication bus. Each PPCU shall be able to support a maximum of 2,000+ physical I/O points.
1. I/O-specific modules (UI, BI, AO, BO) shall require a Terminal Socket Module that includes screw or push-in terminals for field device wires, communication, and port to accept pluggable I/O-specific Module. I/O-specific Modules shall be hot pluggable and shall be replaceable without rewiring.
2. Remote Universal Input Module (8 UI).
   a. Eight Universal Inputs; 0/2-10V, 0/4-20mA, 20K NTC, 10K NTC, PT1000-1, PT1000-2, NI1000TK5000, PT3000, BALCO500, Binary Input (0 / 10V with pull-up).
3. Remote Binary Input Module (12 BI).
   a. Twelve Binary Inputs; Dry contact or Totalizer (20Hz)
   b. Each Binary Input shall include a configurable status LED (Alarm: red/green; Status: yellow/off).
4. Remote Analog Output Module (8 AO).
   a. Eight Analog Outputs with configurable safety position selections. 8 Bit Analog Outputs; 0-10V, Floating Actuator, Binary Output (0V / 10V).
   b. Each Analog Output shall include a RED status LED that varies brightness

based on signal level & flashes in override mode (with manual override Module).
c. Optional version with manual override potentiometer per output.
5. Remote Relay Output Module (6 BO).
a. Six Relay Outputs with configurable safety position selections.
b. Each Relay Output shall include a yellow status LED.
c. Optional version with manual override switch per output (Auto, 0, 1).
6. Remote Floating Output Module (3 FO).
a. Three Floating Outputs with configurable safety position selections. 2 Relays per Floating Output.
b. Each Floating Output shall include a RED status LED (opening) and a GREEN status LED (closing).
c. Manual override potentiometer per output.
7. Remote Mixed I/O Module (8 UI, 12 BI, 8 AO, 6 BO)
a. Eight Universal Inputs; 0/2-10V, 20K NTC, Binary Input (dry contact).
b. Twelve Binary Inputs; Dry contact or Totalizer (15Hz)
1) Each Binary Input shall include a yellow status LED.
c. Eight Analog Outputs with configurable safety position selections. 10 Bit Analog Outputs; 0-10V, Binary Output (0V / 10V).
d. Six Relay Outputs.
1) Each Relay Output shall include a yellow status LED.

R. The PPCU shall be provided with an integrated Local Operator Interface.
1. Local Operator Interface shall allow for User-ID and password protected access.
2. Local Operator Interface shall provide a backlit display, with automatic backlight time-out.
a. The display backlight shall automatically light upon press of a key or operation of the push & turn wheel. The display backlight will extinguish if operating keys or push & turn wheel is not used for two minutes.
3. Local Operator Interface shall provide full display of long text information.
a. Automatic left and right scrolling shall ensure that text information longer than the display width can be viewed.
4. Local Operator Interface shall provide configurable screens for viewing and adjusting data points and parameters, including the following operations.
a. Automatics and visual notification of all critical alarms.
b. Read and write access to all data points.
c. Full length names of data points, schedules, calendars, parameters, alarm texts, state texts and alarms.
d. Read and write access to all application parameters.
e. Read and write access to all schedules and calendars.
f. Read access to the onboard alarm buffer.
g. Overview of all data points in manual override.
h. Overview of all data points in alarm.
5. Local Operator Interface shall allow user access to text information via a push & turn operation wheel.
a. Scrolling through a list of information shall be accomplished by turning the operation wheel.
b. Selecting and acknowledging information shall be accomplished by pushing the operation wheel.
6. Changing information shall be accomplished by turning the operation wheel.

2.8 UNITARY IP CONTROL UNIT (UICU)

A. HVAC UICU controllers shall be fully programmable to meet the unique requirements of the HVAC equipment it shall control. The controller platform shall provide options and advanced system functions, programmable and configurable using Niagara 4 Framework, that allow standard and customizable control solutions required in executing the "Sequence of Operation".

B. All UICUs shall be application programmable and shall always maintain their certification. All control sequences within or programmed into the UICU shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained.

C. The controllers shall be capable of daisy-chain IP communications with other UICU's and peer-to-peer communications with SNC's and with any OWS connected to the BAS, whether the OWS is directly connected, connected via cellular modem, or connected via the Internet.

D. The communication protocols utilized for peer-to-peer communications between UICU's will be Niagara 4 FoxS or BACnet TCP/IP. Use of a proprietary communication protocol for peer-to-peer communications between UICU's is not allowed.

E. The UICU shall be licensed and enabled to support two (2) devices and shall be licensed with the following Open protocol drivers by default:
1. BACnet IP and BACnet MSTP
2. Modbus TCP and Modbus RTU
3. SNMP

F. The UICU shall be provided with Lifetime Software Maintenance license. Labor to implement not included.

G. The UICU shall be capable of executing application control programs to provide:
1. Calendar functions.
2. Scheduling.
3. Trending.
4. Alarm monitoring and routing.
5. Time synchronization.
6. Integration of all daisy-chain UICU's.
7. Network management functions for all daisy-chain UICU's.
8. Analytics for BMS fault detection and diagnostics, including sub-system alarm suppression as described in ASHRAE Guideline 36-2018.
9. 10 Niagara N4 Analytic Points (Expandable).

H. Programming software shall be embedded into the UICU. The UICU shall not require any external configuration tool or programming tool. All configuration and programming tasks shall be accomplished and accessible from within the embedded Niagara 4 environment.

I. The UICU shall support the following security functions.
1. Module code signing to verify the author of programming tool and confirm that the code has not been altered or corrupted.

2. Role-Based Access Control (RBAC) for managing user roles and permissions.
3. Require users to use strong credentials.
4. Data in Motion and Sensitive Data at Rest be encrypted.
5. Encrypted (PKI) Secure IP Stack Communication Security.
6. FIPS 140-2 Level 1 Cryptographic Module Compliant.

J. The minimum controller Environmental ratings.
1. Operating Temperature Ambient Rating: -4 degrees to 140 degrees F (-20 degrees to 60 degrees C).
2. Storage Temperature Ambient Rating: -40 degrees to 185 degrees F (-40 degrees to 85 degrees C).
3. Relative Humidity: 5% to 95% non-condensing

K. The controller shall have the additional approval requirements, listings, and approvals:
1. Meets FCC Part 15, Class B (radiated emissions) requirements.
2. C-UL
3. CE
4. UL916, Open Energy Management Class 2
5. RoHS2
6. REACH
7. WEEE
8. CAN/CSA-C22.2 No. 205-12
9. The controller housing shall be UL plenum rated mounting to either a panel or DIN rail (2.40" x 7.04" x 4.53;" 61mm x 179mm x 115mm).

L. The UICU shall provide the following hardware features as a minimum:
1. The UICU shall provide LED indication of Power, Fault, Ethernet TX/RX/Traffic/Speed without cover removal.
2. ARM Cortex-A9/M4 9, 800 MHz
3. 512 MB DDR SDRAM
4. 2 GB Flash Memory
5. Powered from 24VAC/DC source
6. Two 10/100 MB Ethernet ports capable of daisy chaining
7. 1 RS-485 Serial Port
8. Real Time Clock
9. Secure Boot
10. Ten onboard IO points
11. Supports up to 3 devices or 50 Points

M. The UICU shall support standard Web browser access via the Intranet/Internet.

N. The UICU shall be able to route any alarm condition to any defined user location whether connected to a local network or wide-area network.
1. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but not limited to:
   a. Alarm.
   b. Return to normal.
   c. To default.
2. Alarms shall be annunciated in any of the following manners as defined by the user:
   a. Screen message text.

b. Email of complete alarm message to multiple recipients.
c. Pagers via paging services that initiate a page on receipt of email message.
d. Graphics with flashing alarm object(s).

3. The following shall be recorded by the UICU for each alarm (at a minimum):
a. Time and date.
b. Equipment (air handler #, access way, etc.).
c. Acknowledge time, date, and user who issued acknowledgement.

O. UICU Controllers shall support at minimum the following control techniques:
1. General-purpose control loops that can incorporate Demand Limit Control strategies, Set point reset, adaptive intelligent recovery, and time of day bypass.
2. General-purpose, non-linear control loops.
3. Start/stop Loops.
4. If/Then/Else logic loops.
5. Math Function loops (MIN, MAX, AVG, SUM, SUB, SQRT, MUL, DIV, ENTHALPY).
6. Analytic calculations.

P. The following five (5) Universal Inputs shall be supported per each UICU:
1. Type 3 10K Thermistor.
2. 0-100K ohm.
3. 0-10 VDC.
4. 0-20mA with external resistor.
5. Dry Contact.

Q. The following two (2) Analog Outputs shall be supported per each UICU:
1. 0-10VDC, 4mA max output current.

R. The following three (3) Digital Outputs shall be supported per each UICU:
1. Triac, 24VAC @ 0.5 amp.

S. The UICU shall employ a 50 Point Base License that supports one IO-R-34 expansion module over a shielded RS-485 bus or three devices via the embedded protocols.

T. Each UICU shall have expansion ability to support additional I/O requirements through the use of a remote input/output module connected to an RS-485 local communication bus. Each UICU shall be able to support a maximum of one 34 Point Expansion I/O Modules for a maximum of 44 physical I/O points.
1. 34 Point Mixed Expansion I/O Module shall communicate with UICU via a 2-wire RS-485m bus.
2. Sixteen (16) Universal Inputs shall be supported via 34 Point Expansion I/O Module:
a. Type 3 10K Thermistor.
b. 0-100K ohm.
c. 0-10 VDC.
d. 0-20mA with external resistor.
3. Eight (8) Analog Outputs shall be supported via 34 Point Expansion I/O Module:
a. 0-10.0 Vdc.
4. Ten (10) Digital Outputs (Relay) shall be supported via 34 Point Expansion I/O Module:
a. Form A Contacts, 24 VAC at 0.5 A rated.

U. The UICU shall not include an integrated Local Operator Interface.

2.9 ADVANCED UNITARY CONTROLLER (AUC)

A. The advanced unitary controller (AUC) platform shall be designed specifically to control HVAC - ventilation, filtration, heating, cooling, humidification, and distribution. Equipment includes constant volume air handlers, VAV air handlers, packaged RTU, heat pumps, unit vents, fan coils, natural convection units and radiant panels. The control shall use BACnet based devices where the application has a LonMark profile or BTL Listed PICS defined. Where LonMark devices are not available for a particular application, devices based on LonWorks shall be acceptable. For each LonWorks device that does not have LonMark certification, the device supplier shall provide an XIF file for the device. The controller platform shall provide options and advanced system functions, programmable and configurable, using Niagara 4 Framework, that allow standard and customizable control solutions required in executing the "Sequence of Operation".

B. Minimum Requirements:
   1. The controller shall be fully programmable or configurable with full functionality on any Niagara 4 brand platform.
      a. Support downloads to the controller in Niagara 4 platform.
      b. Support uploads from the controller to Niagara 4 platform.
      c. Support simulation/debug mode of the controller.
      d. Maintain native GUI.
      e. Native function-block programming software and all controller "Setup Wizards" shall be embedded within the Niagara 4 environment.
   2. The AUC shall be capable of either integrating with other devices or stand-alone operation.
   3. For VAV box applications, the AUC shall have an internal velocity pressure sensor.
      a. Sensor Type: Microbridge air flow sensor with dual integral restrictors.
      b. Operating Range: 0 to 1.5 inch H2O (0 to 374 Pa).
      c. Accuracy: +/- 2% of full scale at 32 degrees to 122 degrees F (0 degrees to 50 degrees C); +/- 1% of full scale at null pressure.
   4. The AUC shall have two microprocessors. The Host processor contains on-chip FLASH program memory, FLASH information memory, and RAM to run the main HVAC application. The second processor for network communications. Controller memory minimum requirements include:
      a. FLASH Memory Capacity: 60 Kilobytes with 8 Kilobytes for application program.
      b. FLASH Memory settings retained for ten years.
      c. RAM: 2 Kilobytes.
   5. The AUC shall have an internal time clock with the ability to automatically revert from a master time clock on failure.
      a. Operating Range: 24 hour, 365 day, multi-year calendar including day of week and configuration for automatic day-light savings time adjustment to occur on configured start and stop dates.
      b. Accuracy: +/- 1 minute per month at 77 degrees F (25 degrees C).
      c. Power Failure Backup: 24 hours at 32 degrees to 122 degrees F (0 degrees to 50 degrees C).
   6. The AUC shall have Significant Event Notification, Periodic Update capability, and

Failure Detect when network inputs fail to be detected within their configurable time frame.

7. The AUC shall have an internal DC power supply to power external sensors.
   a. Power Output: 20 VDC +/- 10% at 75 mA.
8. The AUC shall have a visual indication (LED) of the status of the devise:
   a. Controller operating normally.
   b. Controller in process of download.
   c. Controller in manual mode under control of software tool.
   d. Controller lost its configuration.
   e. No power to controller, low voltage, or controller damage.
   f. Processor and/or controller are not operating.
9. The minimum AUC Environmental ratings.
   a. Operating Temperature Ambient Rating: -40 degrees to 150 degrees F (-40 degrees to 65.5 degrees C) for an AUC in unconditioned space.
   b. Storage Temperature Ambient Rating: -40 degrees to 150 degrees F (-40 degrees to 65.5 degrees C) for an AUC in unconditioned space.
   c. Operating Temperature Ambient Rating: 32 degrees to 122 degrees F (0 degrees to 50 degrees C) for an AUC in conditioned space.
   d. Storage Temperature Ambient Rating: 32 degrees to 122 degrees F (0 degrees to 50 degrees C) for an AUC in conditioned space.
   e. Relative Humidity: 5% to 95% non-condensing.
10. The AUC shall have the additional approval requirements, listings, and approvals:
    a. UL/cUL (E87741) listed under UL916 (Standard for Open Energy Management Equipment) with plenum rating.
    b. CSA (LR95329-3) Listed.
    c. Meets FCC Part 15, Subpart B, Class B (radiated emissions) requirements.
    d. Meets Canadian standard C108.8 (radiated emissions).
    e. Conforms requirements European Consortium standard EN 61000-6-1; 2001 (EU Immunity).
    f. Conforms requirements European Consortium standard EN 61000-6-3; 2001 (EU Emission).
11. The AUC housing shall be UL plenum rated mounting to either a panel or DIN rail (standard EN50022; 7.5mm x 35mm).
12. For VAV box applications, the AUC shall provide an integrated actuator option.
    a. Actuator type: Series Floating.
    b. Rotation stroke: 95 degrees +/- 177;3 degrees for CW or CCW opening dampers.
    c. Torque rating: 44 lb-inch (5 Nm).
    d. Run time for 90 degree rotation: 90 seconds at 60 Hz.
13. The AUC shall have a mix of Universal Inputs (UI), Digital Inputs (DI), Analog Outputs (AO), and Digital Triac Outputs (DO), as well as a 2-wire, polarity insensitive, AUC communication bus providing Sensor, Actuator, and I/O expandability.
    a. Analog outputs (AO) shall be capable of being configured as digital outputs (DO).
    b. Input and Output wiring terminal strips shall be removable from the controller without disconnecting wiring.
    c. Input and Output wiring terminals shall be designated with color coded labels.
    d. Universal inputs shall be capable of being configured as binary inputs, resistive inputs, voltage inputs (0-10 VDC), or current inputs (4-20 mA).

14. The AUC shall provide "continuous" automated loop tuning with an Adaptive Integral Algorithm Control Loop.
15. The AUC platform shall have standard HVAC application programs that are modifiable to support both the traditional and specialized "sequence of operations" as outlined in Section 4.
    a. Discharge air control and low limit.
    b. Pressure-dependent dual duct without flow mixing.
    c. Variable air volume with return flow tracking.
    d. Economizer with differential enthalpy.
    e. Minimum airflow coordinated with CO2.
    f. Unit ventilator cycle (1, 2, 3) 2-pipe.
    g. Unit ventilator cycle (1, 2, 3) 2-pipe with face/bypass.
    h. Unit ventilator cycle (1, 2, 3) 4-pipe.
    i. Unit ventilator cycle (1, 2, 3) 4-pipe with EOC valve.
    j. VAV terminal unit.
    k. VAV terminal unit fan speed control.
    l. Series fan.
    m. Parallel fan.
    n. Regulated air volume (room pressurization/de-pressurization).
    o. CV dual-duct.
    p. Room CO2 control.
    q. Room Humidity.
    r. TOD occupancy sensor stand-by set points.

2.10 BACNET TOUCHSCREEN COMMUNICATING THERMOSTAT (BCT)

A. BACnet Conformance
1. Touchscreen communicating thermostats shall be approved by the BTL as meeting the BACnet Application Specific Controller requirements.
2. Touchscreen Communicating Thermostats shall, at a minimum, support MS/TP BACnet LAN types. They shall communicate directly through this BACnet LAN at 9.6, 19.2, 38.4 and 76.8 Kbps, as a native BACnet device.
3. Standard BACnet object types supported shall include, as a minimum, Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Device, File, and Program Object Types.
4. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

B. BCT hardware shall:
1. Include a 32 Bit processor.
2. Include a backlit touchscreen for the user interface, buttons are not allowed.
3. Include Three (3) universal inputs with 12-bit resolution that can accept 3K and 10K Type II thermistors, 0-10VDC, 0- 5 VDC, 4-20mA, and dry contact signals. Inputs on controller may be either analog or digital.
4. Include built-in temperature sensor.
5. Include built-in humidity sensor.
6. Include Six (6) relay outputs on board.
7. Include Two (2) analog outputs with 12-bit resolution. Each auto-detecting for 0-10 V or 4-20 mA control signals.

8. Meet the requirements of Listed Underwriters Laboratory for Open Energy Management Equipment (PAZX) under the UL Standard for Safety 916.
9. Meet the requirements of EMC Directive (European CE Mark) EN 60950.
10. Meet the requirements for FCC Part 15, Class B.
11. Be powered by 24VAC power.

2.11 OTHER CONTROL SYSTEM HARDWARE

A. Motorized economizer control dampers shall be furnished and installed by the AC unit manufacturer. Control damper frames shall be constructed of galvanized steel, formed into changes, and welded or riveted. Dampers shall be galvanized, with nylon bearings. Blade edge seals shall be vinyl. Blade edge and tip seals shall be included for all dampers. Blades shall be 16-gauge minimum and 6 inches wide maximum and frame shall be of welded channel iron. Damper leakage shall not exceed 10 CFM per square foot, at 1.5 inches water gauge static pressure. Honeywell is basis of design.

B. Economizer control damper actuators shall be furnished by the AC unit manufacturer. Two-position or proportional electric actuators shall be direct-mount type sized to provide a minimum of 5 in-lb torque per square foot of damper area. Damper actuators shall be spring return type. Actuators shall be heavy-duty electronic communicating type for positioning automatic dampers in response to a communicating signal from the DDC Controller to which they are connected. Motor shall be of sufficient size to operate damper positively and smoothly to obtain correct sequence as indicated. All applications requiring proportional operation shall utilize a two wire, polarity insensitive bus that provides direct communications between a communicating Actuator device and its associated DDC Controller (PICU or AUC). All actuators shall be UL listed. Honeywell is basis of design.
   1. The Actuator shall accept the following communicated commands:
      a. Actuator Position Command.
      b. Actuator Travel Time.
   2. The Actuator shall provide the following feedback to the Controller.
      a. Actual Position.
      b. Cycle Count.
      c. Status.
      d. Overridden.
   3. The actuator microprocessor control shall provide redundant position feedback methods, feedback potentiometer and counting motor commutations, for accurate position tracking.
   4. The actuator minimum design life shall be: 60,000 full stroke cycles, 60,000 spring-return cycles, and 1,500,000 repositions at rated torque and temperature.
      a. The actuator shall be manufactured under ISO 9001 International Quality Control Standards and be warranted for five years.
   5. The DDC Controller (PICU or AUC) shall provide analytics to provide system alerts at the GUI for the following:
      a. Specific Actuator has reached approximately 90% of life and must be replaced or it will fail soon.
      b. Specific Actuator position fault has been detected and should be checked.

C. Control Valves: Control valves shall be 2-way or 3-way pattern as shown and

constructed for tight shutoff at the pump shut-off head or steam relief valve pressure. Control valves shall operate satisfactorily against system pressures and differentials. Two-position valves shall be ' line' size. Proportional control valves shall be sized for a maximum pressure drop of 5.0 psi at rated flow (unless otherwise noted or scheduled on the drawings). Valves with sizes up to and including 2 inches (51 mm) shall be "screwed" configuration and 2-1/2 inches (63.5 mm) and larger valves shall be "flanged" configuration. All control valves, including terminal unit valves, less than 2 inches (51 mm) shall be ball valves. Electrically-actuated control valves shall include spring return type actuators sized for tight shut-off against system pressures (as specified above) and, when specified, shall be furnished with integral switches for indication of valve position (open-closed). Pneumatic actuators for valves, when utilized, shall be sized for tight shut-off against system pressures (as specified above). Honeywell is basis of design.

D. Control Valve Actuators: Actuators for VAV terminal unit heating coils shall be "drive-open; drive-closed" type. All actuators shall have inherent current limiting motor protection. Valve actuators shall be 24-volt, electronic type, modulating or two-position as required for the correct operating sequence. Actuators on valves needing ' fail-safe' operation shall have spring return to Normal position. All applications requiring proportional operation shall utilize a two wire, polarity insensitive bus that provides direct communications between a communicating Actuator device and its associated DDC Controller (PICU or AUC). All valve actuators shall be UL listed. Honeywell is basis of design.
   1. The Actuator shall accept the following communicated commands:
      a. Actuator Position Command.
      b. Actuator Travel Time.
   2. The Actuator shall provide the following feedback to the Controller.
      a. Actual Position.
      b. Cycle Count.
      c. Status.
      d. Overridden.
   3. The actuator microprocessor control shall provide redundant position feedback methods, feedback potentiometer and counting motor commutations, for accurate position tracking.
   4. The actuator minimum design life shall be: 60,000 full stroke cycles, 60,000 spring-return cycles, and 1,500,000 repositions at rated torque and temperature.
      a. The actuator shall be manufactured under ISO 9001 International Quality Control Standards and be warranted for five years.
   5. The DDC Controller shall provide analytics to provide system alerts at the GUI for the following:
      a. Specific Actuator has reached approximately 90% of life and must be replaced or it will fail soon.
      b. Specific Actuator position fault has been detected and should be checked.

E. All control valves 2-1/2 inches (63.5 mm) or larger shall have position indication. All hot water control valves shall be Normally-Open arrangement; all chilled water control valves shall be Normally-Closed arrangement. Honeywell is basis of design.

F. 6-Way Control Valves: Control valves shall be ½" 6-way pattern ball valves as shown and constructed for tight shutoff at the pump shut-off head pressure. 6-way control valves shall have a static pressure rating of 600psi, close-off pressure rating of 200 psi,

and a maximum differential pressure rating of 50 psid. 6-way control valves shall be rated for 0% leakage at both A-AB port and B-AB port according to EN 12266-1:2003 and have an Equal % flow characteristic curve with 100:1 rangeability. 6-way control valves body construction shall be nickel-plated forged brass, stainless steel ball & stem, PTFE seats, precision machined brass characterizing disc, and EPDM Perox stem O-rings. Proportional control valves shall be sized for a maximum pressure drop of 5.0 psi at rated flow (unless otherwise noted or scheduled on the drawings). Valves shall be Female NPT configuration. All 6-way control valves shall be proportional (floating or two-position available) signal electrically actuated and shall include non-spring return type actuators sized for tight shut-off against system pressures (as specified above). Honeywell is basis of design.

G. Wall Mount Room Temperature sensors: Each room temperature sensor shall provide temperature indication to the digital controller, provide the capability for a software-limited occupant set point adjustment (warmer-cooler slider bar or switch) and limited operation override capability. Room Temperature Sensors shall be 20,000-ohm thermistor type with a temperature range of -40 to 140 degrees F (-38 to 60 degrees C). The sensor shall be complete with a decorative cover and suitable for mounting over a standard electrical utility box. These devices shall have an accuracy of 0.5 degrees F (.024 degrees C) over the entire range. Honeywell is basis of design.

H. Intelligent Wall Module shall include:
   1. Color touch screen.
   2. Temperature Sensor only or Temperature and Humidity Sensors.
   3. Vertical or Horizontal orientation.
   4. Ability to display up to three of the following parameters:
      a. Space Temperature.
      b. Space Humidity.
      c. Space Setpoint.
      d. Outdoor Temperature.
      e. Outdoor Humidity.
      f. Current Time.
      g. Or any one other parameter in the controller.

I. Duct-mounted and Outside Air Temperature Sensors: 20,000-ohm thermistor temperature sensors with an accuracy of +/- 0.2 degrees C. Outside air sensors shall include an integral sun shield. Duct-mounted sensors shall have an insertion measuring probe of a length appropriate for the duct size, with a temperature range of -40 to 160 degrees F(-38 to 71 degrees C) The sensor shall include a utility box and a gasket to prevent air leakage and vibration noise. For all mixed air and preheat air applications, install bendable averaging duct sensors with a minimum 8 feet (2438 mm) long sensor element. These devices shall have accuracy of 0.5 degrees F (.024 degrees C) over the entire range. Honeywell is basis of design.

J. Humidity sensors shall be thin-film capacitive type sensor with on-board nonvolatile memory, accuracy to plus or minus two percent (2%) at 0 to 90% RH, 12 - 30 VDC input voltage, analog output (0 - 10 VDC or 4 - 20mA output). Operating range shall be 0 to 100% RH and 32 to 140 degrees F (0 to 60 degrees C). Sensors shall be selected for wall, duct, or outdoor type installation as appropriate. Honeywell is basis of design.

K. Carbon Dioxide Sensors (CO2): Sensors shall utilize Non-dispersive infrared technology

(N.D.I.R.), repeatable to plus or minus 20 PPM. Sensor range shall be 0 - 2000 PPM. Accuracy shall be plus or minus five percent (5%) or 75 PPM, whichever is greater. Response shall be less than one minute. Input voltage shall be 20 to 30 VAC or DC. Output shall be 0 - 10 VDC. Sensor shall be wall or duct mounted type, as appropriate for the application, housed in a high impact plastic enclosure. Honeywell is basis of design.

L. Current Sensitive Switches: Solid state, split core current switch that operates when the current level (sensed by the internal current transformer) exceeds the adjustable trip point. Current switch to include an integral LED for indication of trip condition and a current level below trip set point. Honeywell is basis of design.

M. Differential Analog (duct) Static Pressure Transmitters Provide a pressure transmitter with integral capacitance type sensing and solid-state circuitry. Accuracy shall be plus or minus 1% of full range; range shall be selected for the specific application. Provide zero and span adjustment capability. Device shall have integral static pickup tube. Honeywell is basis of design.

N. Differential Air Pressure Switches: Provide SPDT type, UL-approved, and selected for the appropriate operating range where applied. Switches shall have adjustable set points and barbed pressure tips. Honeywell is basis of design.

O. Water Flow Switches: Provide a SPST type contact switch with bronze paddle blade, sized for the actual pipe size at the location. If installed outdoors, provide a NEMA-4 enclosure. Flow switch shall be UL listed.

P. Temperature Control Panels: Furnish temperature control panels of code gauge steel with locking doors for mounting all devices as shown. A complete set of ' as-built' control drawings (relating to the controls within that panel) shall be furnished within each control panel.

Q. Pipe and Duct Temperature sensing elements: 20,000-ohm thermistor temperature sensors with and accuracy of +/- 1% accuracy. Their range shall be -5 to 250 degrees F (-20 to 121 degrees C). Limited range sensors shall be acceptable provided they are capable of sensing the range expected for the point at the specified accuracy. Thermal wells with heat conductive gel shall be included. Honeywell is basis of design.

R. Low Air Temperature Sensors: Provide SPST type switch, with 15 to 55 degrees F (-9 to 13 degrees C), range, vapor-charged temperature sensor. Honeywell model L482A, or approved equivalent.

S. Variable Frequency Drives: The variable frequency drive (VFD) shall be designed specifically for use in Heating, Ventilation, and Air Conditioning (HVAC) applications in which speed control of the motor can be applied. The VFD, including all factory installed options, shall have UL & CSA approval. VFD's shall include communications capability with DDC BMS via built-in interface card (MODBUS or BACnet). Honeywell SmartVFD is basis of design.

T. Relays: Start/stop relay model shall provide either momentary or maintained switching action as appropriate for the motor being started. All relays shall be plugged in, interchangeable, mounted on a sub base and wired to numbered terminals strips.

Relays installed in panels shall all be DPDT with indicating lamp. Relays installed outside of controlled devices shall be enclosed in a NEMA enclosure suitable for the location. Relays shall be labeled with UR symbol. RIB-style relays are acceptable for remote enable/disable.

U. Transducers: Differential pressure transducers shall be electronic with a 4-20 mA output signal compatible to the Direct Digital Controller. Wetted parts shall be stainless steel. Unit shall be designed to operate in the pressure ranges involved.

V. Control Power Transformers: Provide step-down transformers for all DDC controllers and devices as required. Transformers shall be sized for the load, but shall be sized for 50 watts, minimum. Transformers shall be UL listed Class 2 type, for 120 VAC/24 VAC operation. Honeywell is basis of design.

W. Line voltage protection: All DDC system control panels that are powered by 120 VAC circuits shall be provided with surge protection. This protection is in addition to any internal protection provided by the manufacturer. The protection shall meet UL, ULC 1449, IEEE C62.41B. A grounding conductor, (minimum 12 AWG), shall be brought to each control panel.

2.12 BAS SERVER & WEB BROWSER GUI - SYSTEM OVERVIEW

A. The BAS Contractor shall provide system software based on server/thin-client architecture, designed around the open standards of web technology. The BAS server shall communicate using Ethernet and TCP. Server shall be accessed using a web browser over Owner intranet and remotely over the Internet.

B. The intent of the thin-client architecture is to provide the operator(s) complete access to the BAS system via a web browser. The thin-client web browser Graphical User Interface (GUI) shall be browser and operating system agnostic, meaning it will support HTML5 enabled browsers without requiring proprietary operator interface and configuration programs or browser plug-ins. Microsoft, Firefox, and Chrome browsers (current released versions), and Windows as well as non-Window operating systems.

C. The BAS server software shall support at least the following server platforms (Windows 10, Server 12). The BAS server software shall be developed and tested by the manufacturer of the system stand-alone controllers and network controllers/routers.

D. The web browser GUI shall provide a completely interactive user interface and shall provide a HTML5 experience that supports the following features as a minimum:
   1. Every point shall be tagged using Haystack dictionary imbedded in Niagara.
   2. Trending.
   3. Scheduling.
   4. Electrical demand limiting.
   5. Duty Cycling.
   6. Downloading Memory to field devices.
   7. Real time 'live' Graphic Programs.
   8. Tree Navigation.
   9. Parameter changes of properties.
   10. Set point adjustments.

11. Alarm / event information.
12. Configuration of operators.
13. Execution of global commands.
14. Add, delete, and modify graphics and displayed data.
15. Analytics for BMS fault detection and diagnostics, including sub-system alarm suppression as described in ASHRAE Guideline 36-2018.
16. Each DDC Controller (PICU or AUC) shall provide analytics to provide system alerts at the GUI for the following:
    a. Specific Actuator has reached approximately 90% of life and must be replaced or it will fail soon.
    b. Specific Actuator position fault has been detected and should be checked.
17. "Actuator Life Dashboard" which shall indicate the amount of actuator life used, and remaining, for all actuators.

E. Software Components: All software shall be the most current version. All software components of the BAS system software shall be provided and installed as part of this project. BAS software components shall include:
1. Server Software, Database and Web Browser Graphical User Interface.
2. One Year Software Maintenance license. Labor to implement not included.
3. Embedded System Configuration Utilities for future modifications to the system and controllers.
4. Embedded Graphical Programming Tools.
5. Embedded Direct Digital Control software.
6. Embedded Application Software.

F. BAS Server Database: The BAS server software shall utilize a Java Database Connectivity (JDBC) compatible database such as: MS SQL 8.0, Oracle 8i or IBM DB2. BAS systems written to Non -Standard and/or Proprietary databases are NOT acceptable.

G. Thin Client - Web Browser Based: The GUI shall be thin client or browser based and shall meet the following criteria:
1. Web Browser's for PC's: Only the current released browser (Explorer/Firefox/Chrome) will be required as the GUI and a valid connection to the server network. No installation of any custom software shall be required on the operator's GUI workstation/client. Connection shall be over an intranet or the Internet.
2. Secure Socket Layers: Communication between the Web Browser GUI and BAS server shall offer encryption using 128-bit encryption technology within Secure Socket Layers (SSL). Communication protocol shall be Hyper-Text Transfer Protocol (HTTP).

2.13 WEB BROWSER GRAPHICAL USER INTERFACE

A. Web Browser Navigation: The Thin Client web browser GUI shall provide a comprehensive user interface. Using a collection of web pages, it shall be constructed to "feel" like a single application, and provide a complete and intuitive mouse/menu driven operator interface. It shall be possible to navigate through the system using a web browser to accomplish requirements of this specification. The Web Browser GUI

shall (as a minimum) provide for navigation, and for display of animated graphics, schedules, alarms/events, live graphic programs, active graphic set point controls, configuration menus for operator access, reports, and reporting actions for events.

B. Login: On launching the web browser and selecting the appropriate domain name or IP address, the operator shall be presented with a login page that will require a login name and strong password. Navigation in the system shall be dependent on the operator's role-based application control privileges.

C. Navigation: Navigation through the GUI shall be accomplished by clicking on the appropriate level of a navigation tree (consisting of an expandable and collapsible tree control like Microsoft's Explorer program) and/or by selecting dynamic links to other system graphics. Both the navigation tree and action pane shall be displayed simultaneously, enabling the operator to select a specific system or equipment and view the corresponding graphic. The navigation tree shall as a minimum provide the following views: Geographic, Network, Groups and Configuration.
   1. Geographic View shall display a logical geographic hierarchy of the system including cities, sites, buildings, building systems, floors, equipment, and objects.
   2. Groups View shall display Scheduled Groups and custom reports.
   3. Configuration View shall display all the configuration categories (Operators, Schedule, Event, Reporting and Roles).

D. Action Pane: The Action Pane shall provide several functional views for each subsystem specified. A functional view shall be accessed by clicking on the corresponding button:
   1. Graphics: Using graphical format suitable for display in a web browser, graphics shall include aerial building/campus views, color building floor-plans, equipment drawings, active graphic set point controls, web content and other valid HTML elements. The data on each graphic page shall automatically refresh.
   2. Search: User shall have multiple options for searching data based upon Tags. Associated equipment, real time data, Properties, and Trends shall be available in result.
   3. Properties: Shall include graphic controls and text for the following: Locking or overriding objects, demand strategies, and any other valid data required for setup. Changes made to the properties pages shall require the operator to depress an 'accept/cancel' button.
   4. Schedules: Shall be used to create, modify/edit and view schedules based on the systems hierarchy (using the navigation tree).
   5. Alarms: Shall be used to view alarm information geographically (using the navigation tree), acknowledge alarms, sort alarms by category, actions and verify reporting actions.
   6. Charting: Shall be used to display associated trend and historical data, modify colors, date range, axis, and scaling. User shall have ability to create HTML charts through web browser without utilizing chart builder. User shall be able to drag and drop single or multiple data points, including schedules, and apply status colors for analysis.
   7. Logic - Live Graphic Programs: Shall be used to display' live' graphic programs of the control algorithm, (micro block programming) for the mechanical/electrical system selected in the navigation tree.
   8. Other actions such as Help, Command, and Logout shall be available via a drop-down window.

E. Color Graphics: The Web Browser GUI shall make extensive use of color in the graphic pane to communicate information related to set points and comfort. Animated .gifs or .jpg, vector scalable, active set point graphic controls shall be used to enhance usability. Graphics tools used to create Web Browser graphics shall be non-proprietary and conform to the following basic criteria:
   1. Display Size: The GUI workstation software shall graphically display in a minimum of 1024 by 768 pixels 24 bit True Color.
   2. General Graphic: General area maps shall show locations of controlled buildings in relation to local landmarks.
   3. Color Floor Plans: Floor plan graphics shall show heating and cooling zones throughout the buildings in a range of colors, as selected by Owner. Provide a visual display of temperature relative to their respective set points. The colors shall be updated dynamically as a zone's actual comfort condition changes.
   4. Mechanical Components: Mechanical system graphics shall show the type of mechanical system components serving any zone through the use of a pictorial representation of components. Selected I/O points being controlled or monitored for each piece of equipment shall be displayed with the appropriate engineering units. Animation shall be used for rotation or moving mechanical components to enhance usability.
   5. Minimum System Color Graphics: Color graphics shall be selected and displayed via a web browser for the following:
      a. Each piece of equipment monitored or controlled including each terminal unit.
      b. Each building.
      c. Each floor and zone controlled.

F. Hierarchical Schedules: Utilizing the Navigation Tree displayed in the web browser GUI, an operator (with proper access credentials) shall be able to define a Normal, Holiday or Override schedule for an individual piece of equipment or room, or choose to apply a hierarchical schedule to the entire system, site, or floor area. For example, Independence Day ' Holiday' for every level in the system would be created by clicking at the top of the geographic hierarchy defined in the Navigation Tree. No further operator intervention would be required and every control module in the system with would be automatically downloaded with the ' Independence Day' Holiday. All schedules that affect the system/area/equipment highlighted in the Navigation Tree shall be shown in a summary schedule table and graph.
   1. Schedules: Schedules shall comply with the LonWorks and BACnet standards, (Schedule Object, Calendar Object, Weekly Schedule property and Exception Schedule property) and shall allow events to be scheduled based on:
      a. Types of schedule shall be Normal, Holiday or Override.
      b. A specific date.
      c. A range of dates.
      d. Any combination of Month of Year (1-12, any), Week of Month (1-5, last, any), Day of Week (M-Sun, Any).
      e. Wildcard (example, allow combinations like second Tuesday of every month).
   2. Schedule Categories: The system shall allow operators to define and edit scheduling categories (different types of "things" to be scheduled; for example, lighting, HVAC occupancy, etc.). The categories shall include name, description, icon (to display in the hierarchy tree when icon option is selected) and type of value to be scheduled.

3. Schedule Groups: In addition to hierarchical scheduling, operators shall be able to define functional Schedule Groups, comprised of an arbitrary group of areas/rooms/equipment scattered throughout the facility and site. For example, the operator shall be able to define an ' individual tenant' group - who may occupy different areas within a building or buildings. Schedules applied to the ' tenant group' shall automatically be downloaded to control modules affecting spaces occupied by the ' tenant group'.
4. Intelligent Scheduling: The control system shall be intelligent enough to automatically turn on any supporting equipment needed to control the environment in an occupied space. If the operator schedules an individual room in a VAV system for occupancy, for example, the control logic shall automatically turn on the VAV air handling unit, chiller, boiler, and/or any other equipment required to maintain the specified comfort and environmental conditions within the room.
5. Partial Day Exceptions: Schedule events shall be able to accommodate a time range specified by the operator (ex: board meeting from 6 pm to 9 pm overrides Normal schedule for conference room).
6. Schedule Summary Graph: The schedule summary graph shall clearly show Normal versus Holiday versus Override Schedules and the net operating schedule that results from all contributing schedules. Note: In case of priority conflict between schedules at the different geographic hierarchy, the schedule for the more detailed geographic level shall apply.

G. Alarms: Alarms associated with a specific system, area, or equipment selected in the Navigation Tree, shall be displayed in the Action Pane by selecting an ' Alarms' view. Alarms, and reporting actions shall have the following capabilities:
1. Alarms View: Each Alarm shall display an Alarms Category (using a different icon for each alarm category), date/time of occurrence, current status, alarm report and a bold URL link to the associated graphic for the selected system, area, or equipment. The URL link shall indicate the system location, address, and other pertinent information. An operator shall easily be able to sort events, edit event templates and categories, acknowledge or force a return to normal in the Events View as specified in this section.
2. Alarm Categories: The operator shall be able to create, edit or delete alarm categories such as HVAC, Maintenance, Fire, or Generator. An icon shall be associated with each alarm category, enabling the operator to easily sort through multiple events displayed.
3. Alarm Templates: Alarm template shall define different types of alarms and their associated properties. As a minimum, properties shall include a reference name, verbose description, severity of alarm, acknowledgement requirements, and high/low limit and out of range information.
4. Alarm Areas: Alarm Areas enable an operator to assign specific Alarm Categories to specific Alarm Reporting Actions. For example, it shall be possible for an operator to assign all HVAC Maintenance Alarm on the 1st floor of a building to email the technician responsible for maintenance. The Navigation Tree shall be used to setup Alarm Areas in the Graphic Pane.
5. Alarm Time/Date Stamp: All events shall be generated at the DDC control module level and comprise the Time/Date Stamp using the standalone control module time and date.
6. Alarm Configuration: Operators shall be able to define the type of Alarm generated per object. A ' network' view of the Navigation Tree shall expose all

objects and their respective Alarm Configuration. Configuration shall include assignment of Alarm, type of Acknowledgement and notification for return to normal or fault status.

7. Alarm Summary Counter: The view of Alarm in the Graphic Pane shall provide a numeric counter, indicating how many Alarms are active (in alarm), require acknowledgement and total number of Alarms in the BAS Server database.
8. Alarm Auto-Deletion: Alarms that are acknowledged and closed shall be auto-deleted from the database and archived to a text file after an operator defined period.
9. Alarm Reporting Actions: Alarm Reporting Actions specified shall be automatically launched (under certain conditions) after an Alarm is received by the BAS server software. Operators shall be able to easily define these Reporting Actions using the Navigation Tree and Graphic Pane through the web browser GUI. Reporting Actions shall be as follows:
    a. Email: Email shall be sent via any POP3-compatible e-mail server (most Internet Service Providers use POP3). Email messages may be copied to several email accounts. Note: Email reporting action shall also be used to support alphanumeric paging services, where email servers support pagers.
    b. File Write: The ASCII File write reporting action shall enable the operator to append operator defined alarm information to any alarm through a text file. The alarm information that is written to the file shall be completely definable by the operator. The operator may enter text or attach other data point information (such as AHU discharge temperature and fan condition upon a high room temperature alarm).
    c. Write Property: The write property reporting action updates a property value in a hardware module.
    d. SNMP: The Simple Network Management Protocol (SNMP) reporting action sends an SNMP trap to a network in response to receiving an alarm.
    e. Run External Program: The Run External Program reporting action launches specified program in response to an event.

H. Trends: As system is engineered, all points shall be enabled to trend. Trends shall both be displayed and user configurable through the Web Browser GUI. Trends shall comprise analog, digital or calculated points simultaneously. A trend log's properties shall be editable using the Navigation Tree and Graphic Pane.
    1. Viewing Trends: The operator shall have the ability to view trends by using the Navigation Tree and selecting a Trends button in the Graphic Pane. The system shall allow y- and x-axis maximum ranges to be specified and shall be able to simultaneously graphically display multiple trends per graph.
    2. Local Trends: Trend data shall be collected locally by Multi-Equipment/Single Equipment general-purpose controllers, and periodically uploaded to the BAS server if historical trending is enabled for the object. Trend data, including run time hours and start time date shall be retained in non-volatile module memory. Systems that rely on a gateway/router to run trends are NOT acceptable.
    3. Resolution. Sample intervals shall be as small as one second. Each trended point will have the ability to be trended at a different trend interval. When multiple points are selected for displays that have different trend intervals, the system will automatically scale the axis.
    4. Dynamic Update. Trends shall be able to dynamically update at operator-defined intervals.
    5. Zoom/Pan. It shall be possible to zoom-in on a particular section of a trend for

more detailed examination and ' pan through' historical data by simply scrolling the mouse.

6. Numeric Value Display. It shall be possible to pick any sample on a trend and have the numerical value displayed.
7. Copy/Paste. The operator shall have the ability to pan through a historical trend and copy the data viewed to the clipboard using standard keystrokes (i.e., CTRL+C, CTRL+V).

I. Security Access: Systems that are accessed from the web browser GUI to BAS server shall require a Login Name and Strong Password. Access to different areas of the BAS system shall be defined in terms of Role-Based Access Control privileges as specified:
   1. Roles: Roles shall reflect the actual roles of different types of operators. Each role shall comprise a set of ' easily understood English language' privileges. Roles shall be defined in terms of View, Edit and Function Privileges.
      a. View Privileges shall comprise: Navigation, Network, and Configuration Trees, Operators, Roles and Privileges, Alarm/Event Template and Reporting Action.
      b. Edit Privileges shall comprise: Set point, Tuning and Logic, Manual Override, and Point Assignment Parameters.
      c. Function Privileges shall comprise: Alarm/Event Acknowledgement, Control Module Memory Download, Upload, Schedules, Schedule Groups, Manual Commands, Print and Alarm/Event Maintenance.
   2. Geographic Assignment of Roles: Roles shall be geographically assigned using a similar expandable/collapsible navigation tree. For example, it shall be possible to assign two HVAC Technicians with similar competencies (and the same operator defined HVAC Role) to different areas of the system.

2.14 GRAPHICAL PROGRAMMING

A. The system software shall include a Graphic Programming Language (GPL) for all DDC control algorithms resident in all control modules. Any system that does not use a drag and drop method of graphical icon programming shall not be accepted. All systems shall use a GPL method used to create a sequence of operations by assembling graphic microblocks that represent each of the commands or functions necessary to complete a control sequence. Microblocks represent common logical control devices used in conventional control systems, such as relays, switches, high signal selectors etc., in addition to the more complex DDC and energy management strategies such as PID loops and optimum start. Each microblock shall be interactive and contain the programming necessary to execute the function of the device it represents.

B. Graphic programming shall be performed while on screen and using a mouse; each microblock shall be selected from a microblock library and assembled with other microblocks necessary to complete the specified sequence. Microblocks are then interconnected on screen using graphic "wires," each forming a logical connection. Once assembled, each logical grouping of microblocks and their interconnecting wires then forms a graphic function block which may be used to control any piece of equipment with a similar point configuration and sequence of operation.

C. Graphic Sequence: The clarity of the graphic sequence shall be such that the operator has the ability to verify that system programming meets the specifications, without

having to learn or interpret a manufacturer's unique programming language. The graphic programming shall be self-documenting and provide the operator with an understandable and exact representation of each sequence of operation.

D. GPL Capabilities: The following is a minimum definition of the capabilities of the Graphic Programming software:
   1. Function Block (FB): Shall be a collection of points, microblocks and wires which have been connected together for the specific purpose of controlling a piece of HVAC equipment or a single mechanical system.
   2. Logical I/O: Input/Output points shall interface with the control modules in order to read various signals and/or values or to transmit signal or values to controlled devices.
   3. Microblocks: Shall be software devices that are represented graphically and may be connected together to perform a specified sequence. A library of microblocks shall be submitted with the control contractors bid.
   4. Wires: Shall be Graphical elements used to form logical connections between microblocks and between logical I/O.
   5. Reference Labels: Labels shall be similar to wires in that they are used to form logical connections between two points. Labels shall form a connection by reference instead of a visual connection, i.e., two points labeled 'A' on a drawing are logically connected even though there is no wire between them.
   6. Parameter: A parameter shall be a value that may be tied to the input of a microblock.
   7. Properties: Dialog boxes shall appear after a microblock has been inserted which has editable parameters associated with it. Default parameter dialog boxes shall contain various editable and non-editable fields, and shall contain 'push buttons' for the purpose of selecting default parameter settings.
   8. Icon: An icon shall be graphic representation of a software program. Each graphic microblock has an icon associated with it that graphically describes its function.
   9. Menu-bar Icon: Shall be an icon that is displayed on the menu bar on the GPL screen, which represents its associated graphic microblock.
   10. Live Graphical Programs: The Graphic Programming software shall support a ' live' mode, where all input/output data, calculated data and set points shall be displayed in a ' live' real-time mode.

2.15 LONWORKS NETWORK MANAGEMENT

A. Systems requiring the use of third-party LonWorks network management tools shall not be accepted.

B. Network management shall include the following services: device identification, device installation, device configuration, device diagnostics, device maintenance and network variable binding.

C. The Network configuration tool shall also provide diagnostics to identify devices on the network, to reset devices and to view health and status counters within devices.

D. These tools shall provide the ability to "learn" an existing LonWorks network, regardless of what network management tool(s) were used to install the existing network, so that

existing LonWorks devices and newly added devices are part of a single network management database.

E. The network management database shall be resident in the Network Area Controller (NAC), ensuring that anyone with proper authorization has access to the network management database at all times. Systems employing network management databases that are not resident at all times and within the control system shall not be accepted.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 GENERAL

A. Install system and materials in accordance with manufacturer's instructions, and as detailed on the project drawing set.

B. Line and low voltage electrical connections to control equipment shown specified or shown on the control diagrams shall be furnished and installed by the Control System Contractor in accordance with these specifications.

C. Equipment furnished by the Mechanical Contractor that is normally wired before installation shall be furnished completely wired. Control wiring normally performed in the field will be furnished and installed by the Control System Contractor.

D. All control devices mounted on the face of control panels shall be clearly identified as to function and system served with permanently engraved phenolic labels.

3.4 WIRING

A. All electrical control wiring to the control panels shall be the responsibility of the Control System Contractor.

B. All wiring shall be in accordance with the Project Electrical Specifications (Division 26),

the National Electrical Code and any applicable local codes. All control wiring shall be installed in raceways.

C. Excess wire shall not be looped or coiled in the controller cabinet.

D. There shall be no drilling on the controller cabinet after the controls are mounted inside.

E. Careful stripping of wire while inside the cabinet is required to ensure that no wire strand fragments land on circuit boards.

F. Use manufacturer-specified wire for all network connections.

G. Read installation instructions carefully. Any unavoidable deviations shall be approved by owner's rep prior to installation.

3.5 ACCEPTANCE TESTING

A. Upon completion of the installation, the Control System Contractor shall load all system software and start-up the system. The Control System Contractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to insure that the system is functioning in full accordance with these specifications.

B. The Control System Contractor shall perform tests to verify proper performance of components, routines, and points. Repeat tests until proper performance results. This testing shall include a point-by-point log to validate 100% of the input and output points of the DDC system operation.

C. System Acceptance: Satisfactory completion is when the Control System Contractor has performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner's Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

3.6 OPERATOR TRAINING

A. During system commissioning and at such time acceptable performance of the Control System hardware and software has been established, the Control System Contractor shall provide on-site operator instruction to the owner's operating personnel. Operator instruction shall be done during normal working hours and shall be performed by a competent representative familiar with the system hardware, software, and accessories.

B. The Control System Contractor shall provide 4 total hours of comprehensive training for system orientation, product maintenance and troubleshooting, programming, and engineering.

3.7 WARRANTY PERIOD SERVICES

A. Equipment, materials, and workmanship incorporated into the work shall be warranted for a period of one year from the time of system acceptance.

B. Within this period, upon notice by the Owner, any defects in the BMS due to faulty materials, methods of installation or workmanship shall be promptly repaired or replaced by the Control System Contractor at no expense to the Owner.

C. Maintenance of Computer Software Programs: The Control System Contractor shall maintain all software during the standard first year warranty period. In addition, all factory or sub-vendor upgrades to software during the first year warranty period shall be added to the systems, when they become available, at no additional cost. In addition to first year standard warranty, software provided by Control System Contractor shall come with a 1 Year Software Maintenance license. All SNC and BAS Servers are included in this coverage. Labor to implement upgrades in years two through five are not included in standard warranty.

D. Maintenance of Control Hardware: The Control System Contractor shall inspect, repair, replace, adjust, and calibrate, as required, the controllers, control devices and associated peripheral units during the warranty period. The Control System Contractor shall then furnish a report describing the status of the equipment, problem areas (if any) noticed during service work, and description of the corrective actions taken. The report shall clearly certify that all hardware is functioning correctly.

E. Service Period: Calls for service by the Owner shall be honored within 24 hours and are not to be considered as part of routine maintenance.

F. Service Documentation: A copy of the service report associated with each owner-initiated service call shall be provided to the owner.

3.8 WARRANTY ACCESS

A. The Owner shall grant to the Control System Contractor reasonable access to the BMS during the warranty period. Remote access to the BMS (for the purpose of diagnostics and troubleshooting, via the Internet, during the warranty period) will be allowed.

3.9 OPERATION & MAINTENANCE MANUALS

A. See Division 1 for requirements. O&M manuals shall include the following elements, as a minimum:
   1. As-built control drawings for all equipment.
   2. As-built Network Communications Diagram.
   3. General description and specifications for all components.

3.10 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

3.11 SEQUENCES OF OPERATION

A. Sequences of operation for AHUs and VAVs should adhere to ASHRAE Guideline 36-2018 standards.

END OF SECTION

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-32 (Per Equipment Manufacturer)

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for the following:
   1. Thermostatic expansion valves.
   2. Solenoid valves.
   3. Hot-gas bypass valves.
   4. Filter dryers.
   5. Strainers.
   6. Pressure-regulating valves.

B. 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. Shop Drawing Scale: 1/4 inch equals 1 foot (1:50).
   2. 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 061000 “Rough Carpentry."

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) or ASTM B 280, Type ACR.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. See Evaluations for discussions of solder and brazing materials.

E. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.

F. Brazing Filler Metals: AWS A5.8.

G. Flexible Connectors:
1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
2. End Connections: Socket ends.

3. Offset Performance: Capable of minimum 3/4-inch (20-mm) misalignment in minimum 7-inch- (180-mm-) long assembly.
4. Pressure Rating: Factory test at minimum 500 psig (3450 kPa).
5. Maximum Operating Temperature: 250 deg F (121 deg C).

2.2 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; Type, Grade, and wall thickness as selected in Part 3 piping applications articles.

B. Wrought-Steel Fittings: ASTM A 234/A 234M, for welded joints.

C. Steel Flanges and Flanged Fittings: ASME B16.5, steel, including bolts, nuts, and gaskets, bevel-welded end connection, and raised face.

D. 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.

E. Flanged Unions:
1. Body: Forged-steel flanges for NPS 1 to NPS 1-1/2 (DN 25 to DN 40) and ductile iron for NPS 2 to NPS 3 (DN 50 to DN 80). Apply rust-resistant finish at factory.
2. Gasket: Fiber asbestos free.
3. Fasteners: Four plated-steel bolts, with silicon bronze nuts. Apply rust-resistant finish at factory.
4. End Connections: Brass tailpiece adapters for solder-end connections to copper tubing.
5. Offset Performance: Capable of minimum 3/4-inch (20-mm) misalignment in minimum 7-inch- (180-mm-) long assembly.
6. Pressure Rating: Factory test at minimum 400 psig (2760 kPa).
7. Maximum Operating Temperature: 330 deg F (165 deg C).

F. Flexible Connectors:
1. Body: Stainless-steel bellows with woven, flexible, stainless-steel-wire-reinforced protective jacket
2. End Connections:
   a. NPS 2 (DN 50) and Smaller: With threaded-end connections.
   b. NPS 2-1/2 (DN 65) and Larger: With flanged-end connections.
3. Offset Performance: Capable of minimum 3/4-inch (20-mm) misalignment in minimum 7-inch- (180-mm-) long assembly.
4. Pressure Rating: Factory test at minimum 500 psig (3450 kPa).
5. Maximum Operating Temperature: 250 deg F (121 deg C).

2.3 VALVES AND SPECIALTIES

A. Diaphragm Packless Valves:
1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
3. Operator: Rising stem and hand wheel.
4. Seat: Nylon.

5. End Connections: Socket, union, or flanged.
6. Working Pressure Rating: 500 psig (3450 kPa).
7. Maximum Operating Temperature: 275 deg F (135 deg C).

B. Packed-Angle Valves:
1. Body and Bonnet: Forged brass or cast bronze.
2. Packing: Molded stem, back seating, and replaceable under pressure.
3. Operator: Rising stem.
4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
5. Seal Cap: Forged-brass or valox hex cap.
6. End Connections: Socket, union, threaded, or flanged.
7. Working Pressure Rating: 500 psig (3450 kPa).
8. Maximum Operating Temperature: 275 deg F (135 deg C).

C. Check Valves:
1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
3. Piston: Removable polytetrafluoroethylene seat.
4. Closing Spring: Stainless steel.
5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
6. End Connections: Socket, union, threaded, or flanged.
7. Maximum Opening Pressure: 0.50 psig (3.4 kPa).
8. Working Pressure Rating: 500 psig (3450 kPa).
9. Maximum Operating Temperature: 275 deg F (135 deg C).

D. Service Valves:
1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Copper spring.
5. Working Pressure Rating: 500 psig (3450 kPa).

E. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.
1. Body and Bonnet: Plated steel.
2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch (16-GRC) conduit adapter, and 24, 115 or 208-V ac coil.
6. Working Pressure Rating: 400 psig (2760 kPa).
7. Maximum Operating Temperature: 240 deg F (116 deg C).
8. Manual operator.

F. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
2. Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Seat Disc: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Working Pressure Rating: 400 psig (2760 kPa).
6. Maximum Operating Temperature: 240 deg F (116 deg C).

G. Thermostatic Expansion Valves: Comply with ARI 750.
1. Body, Bonnet, and Seal Cap: Forged brass or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
5. Suction Temperature: 40 deg F (4.4 deg C).
6. Superheat: Adjustable.
7. Reverse-flow option (for heat-pump applications).
8. End Connections: Socket, flare, or threaded union.
9. Working Pressure Rating: 450 psig (3100 kPa).

H. Hot-Gas Bypass Valves: Comply with UL 429; listed and labeled by an NRTL.
1. Body, Bonnet, and Seal Cap: Ductile iron or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
5. Seat: Polytetrafluoroethylene.
6. Equalizer: Internal or External.
7. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch (16-GRC) conduit adapter, and 24, 115 or 208-V ac coil.
8. End Connections: Socket.
9. Throttling Range: Maximum 5 psig (34 kPa).
10. Working Pressure Rating: 500 psig (3450 kPa).
11. Maximum Operating Temperature: 240 deg F (116 deg C).

I. Straight-Type Strainers:
1. Body: Welded steel with corrosion-resistant coating.
2. Screen: 100-mesh stainless steel.
3. End Connections: Socket or flare.
4. Working Pressure Rating: 500 psig (3450 kPa).
5. Maximum Operating Temperature: 275 deg F (135 deg C).

J. Angle-Type Strainers:
1. Body: Forged brass or cast bronze.
2. Drain Plug: Brass hex plug.
3. Screen: 100-mesh monel.
4. End Connections: Socket or flare.
5. Working Pressure Rating: 500 psig (3450 kPa).
6. Maximum Operating Temperature: 275 deg F (135 deg C).

K. Moisture/Liquid Indicators:
1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in ppm.
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig (3450 kPa).
7. Maximum Operating Temperature: 240 deg F (116 deg C).

L. Replaceable-Core Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina or charcoal.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 (DN 8) connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig (14 kPa).
8. Working Pressure Rating: 500 psig (3450 kPa).
9. Maximum Operating Temperature: 240 deg F (116 deg C).

M. Permanent Filter Dryers: Comply with ARI 730.
1. Body and Cover: Painted-steel shell.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina or charcoal.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 (DN 8) connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig (14 kPa).
8. Working Pressure Rating: 500 psig (3450 kPa).
9. Maximum Operating Temperature: 240 deg F (116 deg C).

N. Mufflers:
1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or flare.
3. Working Pressure Rating: 500 psig (3450 kPa).
4. Maximum Operating Temperature: 275 deg F (135 deg C).

O. Receivers: Comply with ARI 495.
1. Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
2. Comply with UL 207; listed and labeled by an NRTL.
3. Body: Welded steel with corrosion-resistant coating.
4. Tappings: Inlet, outlet, liquid level indicator, and safety relief valve.
5. End Connections: Socket or threaded.
6. Working Pressure Rating: 500 psig (3450 kPa).
7. Maximum Operating Temperature: 275 deg F (135 deg C).

P. Liquid Accumulators: Comply with ARI 495.
1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or threaded.
3. Working Pressure Rating: 500 psig (3450 kPa).
4. Maximum Operating Temperature: 275 deg F (135 deg C).

2.4 REFRIGERANTS

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. Atofina Chemicals, Inc.
   2. DuPont Company; Fluorochemicals Div.
   3. Honeywell, Inc.; Genetron Refrigerants.
   4. INEOS Fluor Americas LLC.

B. ASHRAE 34, R-32: Difluoromethane.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT (Per Equipment Manufacturer installation requirements for refrigerant being used)

A. Suction Lines NPS 1-1/2 (DN 40) and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.

B. Hot-Gas and Liquid Lines: Copper, Type ACR or L (B), annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.

C. Hot-Gas and Liquid Lines: Copper, Type K (A), annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.

D. Hot-Gas and Liquid Lines: Copper, Type ACR, K (A) or L (B), drawn-temper tubing and wrought-copper fittings with 95-5 tin-antimony soldered joints.

E. Hot-Gas and Liquid Lines: Copper, Type ACR, K (A) or L (B), drawn-temper tubing and wrought-copper fittings with Alloy HB soldered joints.

F. Hot-Gas and Liquid Lines:
   1. NPS 5/8 (DN 18) and Smaller: Copper, Type ACR or L (B), annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
   2. NPS 3/4 to NPS 1 (DN 20 to DN 25) and Smaller: Copper, Type K (A), annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
   3. NPS 1-1/4 (DN 32) and Smaller: Copper, Type ACR, K (A) or L (B), drawn-temper tubing and wrought-copper fittings with 95-5 tin-antimony soldered joints.
   4. NPS 1-1/2 to NPS 2 (DN 40 to DN 50): Copper, Type ACR, K (A) or L (B), drawn-temper tubing and wrought-copper fittings with Alloy HB soldered joints.

G. Hot-Gas and Liquid Lines NPS 2 to NPS 4 (DN 50 to DN 100): Schedule 40, black-steel, and wrought-steel fittings with welded joints.

H. Safety-Relief-Valve Discharge Piping: Copper, Type ACR or L (B), annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.

I. Safety-Relief-Valve Discharge Piping: Copper, Type K (A), annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.

J. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, K (A) or L (B), drawn-temper tubing and wrought-copper fittings with 95-5 tin-antimony soldered joints.

K. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, K (A) or L (B), drawn-temper tubing and wrought-copper fittings with Alloy HB soldered joints.

L. Safety-Relief-Valve Discharge Piping:
1. NPS 5/8 (DN 18) and Smaller: Copper, Type ACR or L (B), annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
2. NPS 3/4 to NPS 1 (DN 20 to DN 25) and Smaller: Copper, Type K (A), annealed- or drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.
3. NPS 1-1/4 (DN 32) and Smaller: Copper, Type ACR, K (A) or L (B), drawn-temper tubing and wrought-copper fittings with 95-5 tin-antimony soldered joints.
4. NPS 1-1/2 to NPS 2 (DN 40 to DN 50): Copper, Type ACR, K (A) or L (B), drawn-temper tubing and wrought-copper fittings with Alloy HB soldered joints.

M. Safety-Relief-Valve Discharge Piping NPS 2 to NPS 4 (DN 50 to DN 100): Schedule 40, black-steel, and wrought-steel fittings with welded joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

A. Install diaphragm packless or packed-angle valves in suction and discharge lines of compressor.

B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.

C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.

D. Except as otherwise indicated, install diaphragm packless or packed-angle valves on inlet and outlet side of filter dryers.

E. Install a full-sized, three-valve bypass around filter dryers.

F. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.

G. Install thermostatic expansion valves as close as possible to distributors on evaporators.
1. Install valve so diaphragm case is warmer than bulb.
2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

H. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.

I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:
   1. Solenoid valves.
   2. Thermostatic expansion valves.
   3. Hot-gas bypass valves.
   4. Compressor.

K. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.

L. Install receivers sized to accommodate pump-down charge.

M. Install flexible connectors at compressors.

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. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

K. 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.

L. Install refrigerant piping in protective conduit where installed belowground.

M. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

N. 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. Use double-suction riser for maximum compressor efficiencies if load variation is expected.
4. Install traps and double risers to entrain oil in vertical runs.
5. Liquid lines may be installed level.

O. 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.

P. Before installation of steel refrigerant piping, clean pipe and fittings using the following procedures:
1. Shot blast the interior of piping.
2. Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through tubing by means of a wire or electrician's tape.
3. Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.
4. Draw a clean, lintless cloth, saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint. Inspect tube or pipe visually for remaining dirt and lint.
5. Finally, draw a clean, dry, lintless cloth through the tube or pipe.
6. Safety-relief-valve discharge piping is not required to be cleaned but is required to be open to allow unrestricted flow.

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.

U. Install escutcheons for piping penetrations of walls, ceilings, and floors.

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. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."

E. 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.

F. Threaded Joints: Thread steel 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. Steel pipe can be threaded, but threaded joints must be seal brazed or seal welded.

H. Welded Joints: Construct joints according to AWS D10.12/D10.12M.

I. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

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. Verify actual supported loads for hanger sizes and spacing. Consult structural engineer. Spacing and sizes in subparagraphs below are from the 2000 ASHRAE HANDBOOK - "HVAC Systems and Equipment."
   2. NPS 1/2 (DN 15): Maximum span, 60 inches (1500 mm); minimum rod size, 1/4 inch (6.4 mm).
   3. NPS 5/8 (DN 18): Maximum span, 60 inches (1500 mm); minimum rod size, 1/4 inch (6.4 mm).
   4. NPS 1 (DN 25): Maximum span, 72 inches (1800 mm); minimum rod size, 1/4 inch (6.4 mm).
   5. NPS 1-1/4 (DN 32): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
   6. NPS 1-1/2 (DN 40): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
   7. NPS 2 (DN 50): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
   8. NPS 2-1/2 (DN 65): Maximum span, 108 inches (2700 mm); minimum rod size, 3/8 inch (9.5 mm).
   9. NPS 3 (DN 80): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (9.5 mm).
   10. 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

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. Single-wall round and flat-oval ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.
7. Seismic-restraint devices.

B. Related Sections:
1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 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 and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7.
1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.
2. Seismic Hazard Level B: Seismic force to weight ratio, 0.30.
3. Seismic Hazard Level C: Seismic force to weight ratio, 0.15.

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 the following products:
   1. Liners and adhesives.
   2. Sealants and gaskets.
   3. Seismic-restraint devices.

B. Shop Drawings:
   1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
   2. Factory- and shop-fabricated ducts and fittings.
   3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
   4. Elevation of top of ducts.
   5. Dimensions of main duct runs from building grid lines.
   6. Fittings.
   7. Reinforcement and spacing.
   8. Seam and joint construction.
   9. Penetrations through fire-rated and other partitions.
   10. Equipment installation based on equipment being used on Project.
   11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
   12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

C. Delegated-Design Submittal:
   1. Sheet metal thicknesses.
   2. Joint and seam construction and sealing.
   3. Reinforcement details and spacing.
   4. Materials, fabrication, assembly, and spacing of hangers and supports.
   5. Design Calculations: Calculations, for selecting hangers and supports and seismic restraints.

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. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports; AWS D1.2/D1.2M, "Structural Welding Code - "Sheet Metal Welding Code," for duct joint and seam welding.

B. 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 D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

D. 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 SINGLE-WALL ROUND AND FLAT-OVAL 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.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Lindab Inc.
      b. McGill AirFlow LLC.
      c. SEMCO Incorporated.
      d. Sheet Metal Connectors, Inc.
      e. Spiral Manufacturing Co., Inc.
      f. Or approved equal

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   1. Transverse Joints in Ducts Larger Than 60 Inches (1524 mm) in Diameter: Flanged.

D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   1. Fabricate round ducts larger than 90 inches (2286 mm) in diameter with butt-welded longitudinal seams.
   2. Fabricate flat-oval ducts larger than 72 inches (1830 mm) in width (major dimension) with butt-welded longitudinal seams.

E. 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."

2.3 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. Factory- or Shop-Applied Antimicrobial Coating:
   1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating shall be applied to the exterior surface.
   2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
   3. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested according to ASTM D 3363.
   4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
   5. Shop-Applied Coating Color: Black .
   6. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.

D. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
   1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

E. 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).

2.4 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. CertainTeed Corporation; Insulation Group.
      b. Johns Manville.
      c. Knauf Insulation.
      d. Owens Corning.
      e. Or approved equal
   2. 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.
   3. Solvent-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. 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-) 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.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized steel, aluminum, or stainless 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.

C. 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. 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.

2.5 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Water-Based Joint and Seam Sealant:
1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.

5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

C. Flanged Joint Sealant: Comply with ASTM C 920.
1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
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."

D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

2.6 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 Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

G. Trapeze and Riser Supports:
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

2.7 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Kinetics Noise Control.
2. Mason Industries.
3. Unistrut Corporation; Tyco International, Ltd.
4. Or approved equal

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of the ICC Evaluation Service, the Office of Statewide Health Planning and Development for the State of California 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.

C. 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.

D. 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.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or Reinforcing steel angle clamped to hanger rod.

F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 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 and flat-oval 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. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

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 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. Outdoor, Supply-Air Ducts: Seal Class A.

3. Outdoor, Exhaust Ducts: Seal Class C.
4. Outdoor, Return-Air Ducts: Seal Class C.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.
8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches (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.

3.5 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.
   1. Space lateral supports a maximum of 40 feet (12 m) o.c., and longitudinal supports a maximum of 80 feet (24 m) o.c.
   2. Brace a change of direction longer than 12 feet (3.7 m).

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints on ducts that are suspended with vibration isolators.

E. Install seismic-restraint devices using methods approved by an evaluation service member of the ICC Evaluation Service, the Office of Statewide Health Planning and Development for the State of California or an agency acceptable to authorities having jurisdiction.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

G. Drilling for and Setting Anchors:
   1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
   2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
   3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
   4. Set anchors to manufacturer's recommended torque, using a torque wrench.
   5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.6 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.

3.7 PAINTING (BY OTHERS)

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:
   1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
   2. Test the following systems:
      a. Ducts with a Pressure Class Higher Than 3-Inch wg (750 Pa): Test representative duct sections, selected by Architect from sections installed, totaling no less than 25 percent of total installed duct area for each designated pressure class.
      b. Supply Ducts with a Pressure Class of 2-Inch wg (500 Pa) or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 100 percent of total installed duct area for each designated pressure class.
      c. Return Ducts with a Pressure Class of 2-Inch wg (500 Pa) or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 100 percent of total installed duct area for each designated pressure class.
      d. Exhaust Ducts with a Pressure Class of 2-Inch wg (500 Pa) or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 100 percent of total installed duct area for each designated pressure class.
      e. Outdoor Air Ducts with a Pressure Class of 2-Inch wg (500 Pa) or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 100 percent of total installed duct area for each designated pressure class.
   3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
   4. Test for leaks before applying external insulation.
   5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
   6. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:
   1. Visually inspect duct system to ensure that no visible contaminants are present.
   2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.9 START UP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.10 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
1. Exhaust ducts in shower areas shall be constructed of aluminum.

B. Supply Ducts:
1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units :
a. Pressure Class: Positive 2-inch wg (500 Pa).
b. Minimum SMACNA Seal Class: C.
c. SMACNA Leakage Class for Rectangular: 12
d. SMACNA Leakage Class for Round and Flat Oval: 12.
2. Ducts Connected to Constant-Volume Air-Handling Units:
a. Pressure Class: Positive 2-inch wg (500 Pa).
b. Minimum SMACNA Seal Class: B.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round and Flat Oval: 12.
3. Ducts Connected to Variable-Air-Volume Air-Handling Units:
a. Pressure Class: Positive 4-inch wg (1000 Pa).
b. Minimum SMACNA Seal Class: B.
c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round and Flat Oval: 6.

C. Return Ducts:
1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
b. Minimum SMACNA Seal Class: C.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round and Flat Oval: 12.
2. Ducts Connected to Air-Handling Units:
a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
b. Minimum SMACNA Seal Class: B.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round and Flat Oval: 12.
3. Ducts Connected to Equipment Not Listed Above:
a. SMACNA Leakage Class for Rectangular: 12.
b. SMACNA Leakage Class for Round and Flat Oval: 12.

D. Exhaust Ducts:
   1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
      a. Pressure Class: Negative 2-inch wg (500 Pa).
      b. Minimum SMACNA Seal Class: C if negative pressure, and A if positive pressure.
      c. SMACNA Leakage Class for Rectangular: 12.
      d. SMACNA Leakage Class for Round and Flat Oval: 12.
   2. Ducts Connected to Air-Handling Units:
      a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
      b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
      c. SMACNA Leakage Class for Rectangular: 12.
      d. SMACNA Leakage Class for Round and Flat Oval: 12.
   3. Ducts Connected to Equipment Not Listed Above:
      a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
      b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
      c. SMACNA Leakage Class for Rectangular: 12.
      d. SMACNA Leakage Class for Round and Flat Oval: 12.

E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
   1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
      a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
      b. Minimum SMACNA Seal Class: C.
      c. SMACNA Leakage Class for Rectangular: 12.
      d. SMACNA Leakage Class for Round and Flat Oval: 12.
   2. Ducts Connected to Air-Handling Units:
      a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
      b. Minimum SMACNA Seal Class: B.
      c. SMACNA Leakage Class for Rectangular: 12.
      d. SMACNA Leakage Class for Round and Flat Oval: 12.
   3. Ducts Connected to Equipment Not Listed Above:
      a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
      b. Minimum SMACNA Seal Class: B.
      c. SMACNA Leakage Class for Rectangular: 6.
      d. SMACNA Leakage Class for Round and Flat Oval: 6.

F. Intermediate Reinforcement:
   1. Galvanized-Steel Ducts: Galvanized steel, Carbon steel coated with zinc-chromate primer or Galvanized steel or carbon steel coated with zinc-chromate primer.

G. Liner:
   1. Supply Air Ducts: Fibrous glass, Type I, 1 inch (25 mm) thick.
   2. Return Air Ducts: Fibrous glass, Type I, 1 inch (25 mm) thick.
   3. Exhaust Air Ducts: Fibrous glass, Type I, 1 inch (25 mm) thick.
   4. Supply Fan Plenums: Fibrous glass, Type II, 1 inch (25 mm) thick.
   5. Return- and Exhaust-Fan Plenums: Fibrous glass, Type II, 2 inches (51 mm) thick.
   6. Transfer Ducts: Fibrous glass, Type I, 1 inch (25 mm) thick.

H. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
    a. Velocity 1000 fpm (5 m/s) or Lower:
        1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
        2) Mitered Type RE 4 without vanes.
    b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s):
        1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
        2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
        3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
    c. Velocity 1500 fpm (7.6 m/s) or Higher:
        1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
        2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
        3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
    a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
    b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
    c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
    a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
        1) Velocity 1000 fpm (5 m/s) or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
        2) Velocity 1000 to 1500 fpm (5 to 7.6 m/s): 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
        3) Velocity 1500 fpm (7.6 m/s) or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
        4) Radius-to Diameter Ratio: 1.5.
    b. Round Elbows, 12 Inches (305 mm) and Smaller in Diameter: Stamped or pleated.
    c. Round Elbows, 14 Inches (356 mm) and Larger in Diameter: Standing seam or Welded.

I. Branch Configuration:
    1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
        a. Rectangular Main to Rectangular Branch: 45-degree entry.
        b. Rectangular Main to Round Branch: Spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
   a. Velocity 1000 fpm (5 m/s) or Lower: 90-degree tap.
   b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s): Conical tap.
   c. Velocity 1500 fpm (7.6 m/s) or Higher: 45-degree lateral.

END OF SECTION

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. Barometric relief dampers.
3. Manual volume dampers.
4. Control dampers.
5. Combination fire and smoke dampers.
6. Flange connectors.
7. Turning vanes.
8. Duct-mounted access doors.
9. Duct access panel assemblies.
10. Flexible connectors.
11. Flexible ducts.
12. Duct accessory hardware.

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.

1.3 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.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.5 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. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

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, and having a No. 2 finish for concealed ducts and No. 4 finish for exposed ducts.

C. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

D. Extruded Aluminum: Comply with ASTM B 221 (ASTM B 221M), Alloy 6063, Temper T6.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

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).

2.3 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Air Balance Inc.; a division of Mestek, Inc.
   2. Greenheck Fan Corporation.
   3. Nailor Industries Inc.
   4. Pottorff.
   5. Ruskin Company.
   6. United Enertech - Chattanooga, TN.
   7. Or approved equal

B. Description: Gravity balanced.

C. Maximum Air Velocity: 1000 fpm (5.1 m/s).

D. Maximum System Pressure: 1-inch wg (0.25 kPa).

E. Frame: Hat-shaped, 0.063-inch- (1.6-mm-) thick extruded aluminum or 0.05-inch- (1.3-mm-) thick stainless steel, with welded corners or mechanically attached and mounting flange.

F. Blades: Multiple single-piece blades, center pivoted, off-center pivoted, or end pivoted, maximum 6-inch (150-mm) width, 0.050-inch- (1.2-mm-) thick aluminum sheet with sealed edges.

G. Blade Action: Parallel.

H. Blade Seals: Extruded vinyl, mechanically locked or Neoprene, mechanically locked.

I. Blade Axles:
   1. Material: Galvanized steel, Stainless steel, or Aluminum.
   2. Diameter: 0.20 inch (5 mm).

J. Tie Bars and Brackets: Aluminum or Galvanized steel.

K. Return Spring: Adjustable tension.

L. Bearings: Steel ball or synthetic pivot bushings.

M. Accessories:
   1. Adjustment device to permit setting for varying differential static pressure.
   2. Counterweights and spring-assist kits for vertical airflow installations.
   3. Electric actuators.
   4. Chain pulls.
   5. Screen Mounting: Front mounted in sleeve.
      a. Sleeve Thickness: 20 gage (1.0 mm) minimum.
      b. Sleeve Length: 6 inches (152 mm) minimum.
   6. Screen Mounting: Rear mounted.
   7. Screen Material: Galvanized steel or Aluminum.
   8. Screen Type: Insect.
   9. 90-degree stops.

2.4 BAROMETRIC RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Air Balance Inc.; a division of Mestek, Inc.
   2. Greenheck Fan Corporation.
   3. Nailor Industries Inc.
   4. Pottorff.
   5. Ruskin Company.
   6. United Enertech.
   7. Or approved equal

B. Suitable for horizontal or vertical mounting.

C. Maximum Air Velocity: 1000 fpm (5.1 m/s).

D. Maximum System Pressure: 2-inch wg (0.5 kPa).

E. Frame: Hat-shaped, 0.063-inch- (1.6-mm-) thick extruded aluminum or 0.05-inch- (1.3-mm-) thick stainless steel, with welded corners or mechanically attached and mounting flange.

F. Blades:
   1. Multiple, 0.050-inch- (1.2-mm-) thick aluminum sheet.
   2. Maximum Width: 6 inches (150 mm).
   3. Action: Parallel.
   4. Balance: Gravity.
   5. Eccentrically pivoted, Off-center pivoted or End pivoted.

G. Blade Seals: Vinyl or Neoprene.

H. Blade Axles: Galvanized steel, Nonferrous metal, Plated steel, Stainless steel or Nonmetallic.

I. Tie Bars and Brackets:
   1. Material: Aluminum or Galvanized steel.
   2. Rattle free with 90-degree stop.

J. Return Spring: Adjustable tension.

K. Bearings: Synthetic, Stainless steel or Bronze.

L. Accessories:
   1. Flange on intake.
   2. Adjustment device to permit setting for varying differential static pressures.

2.5 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Air Balance Inc.; a division of Mestek, Inc.
b. McGill AirFlow LLC.
c. Nailor Industries Inc.
d. Pottorff.
e. Ruskin Company.
f. United Enertech.
g. Or approved equal

2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames:
   a. Frame: Hat-shaped, 0.094-inch- (2.4-mm-) thick, galvanized sheet steel or 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.
5. Blades:
   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Stiffen damper blades for stability.
   d. Galvanized or Stainless-steel, 0.064 inch (1.62 mm) thick.
6. Blade Axles: Galvanized steel or Stainless steel.
7. Bearings:
   a. Oil-impregnated bronze, Molded synthetic, Oil-impregnated stainless-steel sleeve or 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.
8. Tie Bars and Brackets: Galvanized steel.

B. Standard, Aluminum, Manual Volume Dampers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Air Balance Inc.; a division of Mestek, Inc.
   b. McGill AirFlow LLC.
   c. Nailor Industries Inc.
   d. Pottorff.
   e. Ruskin Company.
   f. United Enertech.
   g. Or approved equal
2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames: Hat-shaped, 0.10-inch- (2.5-mm-) thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:
   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Stiffen damper blades for stability.
   d. Roll-Formed Aluminum Blades: 0.10-inch- (2.5-mm-) thick aluminum sheet.
   e. Extruded-Aluminum Blades: 0.050-inch- (1.2-mm-) thick extruded aluminum.
6. Blade Axles: Galvanized steel, Stainless steel, or Nonferrous metal.
7. Bearings:
   a. Oil-impregnated bronze, Molded synthetic or 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.

8. Tie Bars and Brackets: Aluminum.

C. Low-Leakage, Steel, Manual Volume Dampers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Air Balance Inc.; a division of Mestek, Inc.
   b. McGill AirFlow LLC.
   c. Nailor Industries Inc.
   d. Pottorff.
   e. Ruskin Company.
   f. United Enertech.
   g. Or approved equal
2. Comply with AMCA 500-D testing for damper rating.
3. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
4. Suitable for horizontal or vertical applications.
5. Frames:
   a. Hat shaped.
   b. 0.094-inch- (2.4-mm-) thick, galvanized sheet steel or 0.05-inch- (1.3-mm-) thick stainless steel.
   c. Mitered and welded corners.
   d. Flanges for attaching to walls and flangeless frames for installing in ducts.
6. Blades:
   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Stiffen damper blades for stability.
   d. Galvanized or Stainless, roll-formed steel, 0.064 inch (1.62 mm) thick.
7. Blade Axles: Galvanized steel, Stainless steel, or Nonferrous metal.
8. Bearings:
   a. Oil-impregnated bronze, Molded synthetic, Oil-impregnated stainless-steel sleeve or 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.
9. Blade Seals: Felt, Vinyl or Neoprene.
10. Jamb Seals: Cambered stainless steel or aluminum.
11. Tie Bars and Brackets: Galvanized steel or Aluminum.
12. Accessories:
   a. Include locking device to hold single-blade dampers in a fixed position without vibration.

D. Low-Leakage, Aluminum, Manual Volume Dampers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Air Balance Inc.; a division of Mestek, Inc.
   b. McGill AirFlow LLC.
   c. Nailor Industries Inc.
   d. Pottorff.

e. Ruskin Company.
f. United Enertech.
g. Or approved equal

2. Comply with AMCA 500-D testing for damper rating.
3. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
4. Suitable for horizontal or vertical applications.
5. Frames: Hat-shaped, 0.10-inch- (2.5-mm-) thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
6. Blades:
   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Roll-Formed Aluminum Blades: 0.10-inch- (2.5-mm-) thick aluminum sheet.
   d. Extruded-Aluminum Blades: 0.050-inch- (1.2-mm-) thick extruded aluminum.
7. Blade Axles: Galvanized steel, Stainless steel, or Nonferrous metal.
8. Bearings:
   a. Oil-impregnated bronze, Molded synthetic, Oil-impregnated stainless-steel sleeve or 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.
9. Blade Seals: Felt, Vinyl or Neoprene.
10. Jamb Seals: Cambered stainless steel or aluminum.
11. Tie Bars and Brackets: Galvanized steel or Aluminum.
12. Accessories:
    a. Include locking device to hold single-blade dampers in a fixed position without vibration.

E. Jackshaft:
1. Size: 1-inch (25-mm) diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

F. Damper Hardware:
1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- (2.4-mm-) thick zinc-plated steel, and a 3/4-inch (19-mm) hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.6 CONTROL DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Warming and Ventilating; a division of Mestek, Inc.
2. Greenheck Fan Corporation.
3. McGill AirFlow LLC.
4. Nailor Industries Inc.
5. Pottorff.

6. Ruskin Company.
7. United Enertech.
8. Or approved equal

B. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

C. Frames:
1. Hat shaped.
2. 0.094-inch- (2.4-mm-) thick, galvanized sheet steel or 0.05-inch- (1.3-mm-) thick stainless steel.
3. Mitered and welded or Interlocking, gusseted corners.

D. Blades:
1. Multiple blade with maximum blade width of 6 inches (152 mm).
2. Opposed-blade design.
3. Galvanized-steel, Stainless steel or Aluminum.
4. 0.064 inch (1.62 mm) thick single skin or 0.0747-inch- (1.9-mm-) thick dual skin.
5. Blade Edging: Closed-cell neoprene or PVC.
6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.

E. Blade Axles: 1/2-inch- (13-mm-) diameter; galvanized steel, stainless steel, or nonferrous metal; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
1. Operating Temperature Range: From minus 40 to plus 200 deg F (minus 40 to plus 93 deg C).

F. Bearings:
1. Oil-impregnated bronze, Molded synthetic, Oil-impregnated stainless-steel sleeve or Stainless-steel sleeve.
2. 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.
3. Thrust bearings at each end of every blade.

2.7 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Greenheck Fan Corporation.
2. Nailor Industries Inc.
3. Pottorff.
4. Ruskin Company.
5. United Enertech.
6. Or approved equal

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, interlocking, gusseted or mechanically attached corners and mounting flange.

F. Heat-Responsive Device: Resettable or Replaceable, 165 deg F (74 deg C) rated, fusible links or fire-closure device.

G. Heat-Responsive Device: Electric resettable link or device and switch package, factory installed, rated.

H. Smoke Detector: Integral, factory wired for single-point connection.

I. Blades: Roll-formed, horizontal, interlocking or overlapping, 0.063-inch- (1.6-mm-) thick, galvanized sheet steel.

J. Leakage: Class II.

K. Rated pressure and velocity to exceed design airflow conditions.

L. Mounting Sleeve: Factory-installed, 0.05-inch- (1.3-mm-) thick, galvanized sheet steel; length to suit wall or floor application.

M. Master control panel for use in dynamic smoke-management systems.

N. Damper Motors: Two-position action.

O. 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 for 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.

P. Accessories:
   1. Auxiliary switches for signaling fan control or position indication.

2. Momentary test switch, remote mounted.

2.8 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ductmate Industries, Inc.
   2. Nexus PDQ; Division of Shilco Holdings Inc.
   3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
   4. Or approved equal

B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.9 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ductmate Industries, Inc.
   2. Elgen Manufacturing.
   3. METALAIRE, Inc.
   4. SEMCO Incorporated.
   5. Or approved equal

B. 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.

C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

D. 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."

E. Vane Construction: Double wall.

F. Vane Construction: Single wall for ducts up to 48 inches (1200 mm) wide and double wall for larger dimensions.

2.10 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Greenheck Fan Corporation.
   2. McGill AirFlow LLC.
   3. Nailor Industries Inc.
   4. Pottorff.
   5. Ventfabrics, Inc.
   6. United Enertech.
   7. Or approved equal

B. 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 18 Inches (460 mm) Square: Two hinges or Continuous and two sash locks.
      c. Access Doors up to 24 by 48 Inches (600 by 1200 mm): Three hinges or Continuous and two compression latches with outside and inside handles.
      d. Access Doors Larger Than 24 by 48 Inches (600 by 1200 mm): Four hinges or Continuous and two compression latches with outside and inside handles.

C. Pressure Relief Access Door:
   1. Door and Frame Material: Galvanized sheet steel.
   2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.
   3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
   4. Factory set at 3.0- to 8.0-inch wg (800 to 2000 Pa).
   5. Doors close when pressures are within set-point range.
   6. Hinge: Continuous piano.
   7. Latches: Cam.
   8. Seal: Neoprene or foam rubber.
   9. Insulation Fill: 1-inch- (25-mm-) thick, fibrous-glass or polystyrene-foam board.

2.11 DUCT ACCESS PANEL ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ductmate Industries, Inc.
   2. Flame Gard, Inc.
   3. 3M.
   4. Or approved equal

B. Labeled according to UL 1978 by an NRTL.

C. Panel and Frame: Minimum thickness 0.0528-inch (1.3-mm) carbon or 0.0428-inch (1.1-mm) stainless steel.

D. Fasteners: Carbon or Stainless steel. Panel fasteners shall not penetrate duct wall.

E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F (1093 deg C).

F. Minimum Pressure Rating: 10-inch wg (2500 Pa), positive or negative.

2.12 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by the following provide products by one of the following:
   1. Ductmate Industries, Inc.
   2. Duro Dyne Inc.
   3. Elgen Manufacturing.
   4. Ventfabrics, Inc.
   5. Or approved equal

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 5-3/4 inches (146 mm) wide attached to two strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized sheet steel or 0.032-inch- (0.8-mm-) thick aluminum sheets. Provide metal compatible with connected ducts.

E. 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).

F. 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).

G. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.
1. Minimum Weight: 16 oz./sq. yd. (542 g/sq. m).
2. Tensile Strength: 285 lbf/inch (50 N/mm) in the warp and 185 lbf/inch (32 N/mm) in the filling.
3. Service Temperature: Minus 67 to plus 500 deg F (Minus 55 to plus 260 deg C).

H. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.
1. Minimum Weight: 14 oz./sq. yd. (474 g/sq. m).
2. Tensile Strength: 450 lbf/inch (79 N/mm) in the warp and 340 lbf/inch (60 N/mm) in the filling.
3. Service Temperature: Minus 67 to plus 500 deg F (Minus 55 to plus 260 deg C).

I. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch (6-mm) movement at start and stop.

2.13 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Flexmaster U.S.A., Inc.
2. McGill AirFlow LLC.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
4. Or approved equal

B. Noninsulated, Flexible Duct: UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire.
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).

C. Noninsulated, Flexible Duct: UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound, spring-steel wire.
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).

D. Noninsulated, Flexible Duct: UL 181, Class 0, interlocking spiral of aluminum foil.
1. Pressure Rating: 8-inch wg (2280 Pa) positive or negative.
2. Maximum Air Velocity: 5000 fpm (25 m/s).
3. Temperature Range: Minus 100 to plus 435 deg F (Minus 73 to plus 224 deg C).

E. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized 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 10 to plus 160 deg F (Minus 23 to plus 71 deg C).
4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.

F. Insulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
1. Pressure Rating: 4-inch wg (1000 Pa) positive and 0.5-inch wg (125 Pa) negative.
2. Maximum Air Velocity: 4000 fpm (20 m/s).
3. Temperature Range: Minus 20 to plus 175 deg F (Minus 29 to plus 79 deg C).
4. Insulation R-Value: Comply with ASHRAE/IESNA 90.1.

G. Insulated, Flexible Duct: UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized 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 ASHRAE/IESNA 90.1.

H. Insulated, Flexible Duct: UL 181, Class 0, interlocking spiral of aluminum foil; fibrous-glass insulation; aluminized vapor-barrier film.
1. Pressure Rating: 8-inch wg (2280 Pa) positive or negative.
2. Maximum Air Velocity: 5000 fpm (25 m/s).
3. Temperature Range: Minus 20 to plus 250 deg F (Minus 29 to plus 121 deg C).
4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.

I. Flexible Duct Connectors:
1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action or Nylon strap in sizes 3 through 18 inches (75 through 460 mm), to suit duct size.

2.14 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. Install duct security bars. Construct duct security bars from 0.164-inch (4.18-mm)steel sleeve, continuously welded at all joints and 1/2-inch- (13-mm-) diameter steel bars, 6 inches (150 mm) o.c. in each direction in center of sleeve. Weld each bar to steel sleeve and each crossing bar. Weld 2-1/2-by-2-1/2-by-1/4-inch (63-by-63-by-6-mm) steel angle to 4 sides and both ends of sleeve. Connect duct security bars to ducts with flexible connections. Provide 12-by-12-inch (300-by-300-mm) hinged access panel with cam lock in duct in each side of sleeve.

I. Connect ducts to duct silencers with flexible duct connectors or rigidly.

J. 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.

K. Install access doors with swing against duct static pressure.

L. 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).

M. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

N. Install flexible connectors to connect ducts to equipment.

O. 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.

P. Connect terminal units to supply ducts directly or with maximum 12-inch (300-mm) lengths of flexible duct. Do not use flexible ducts to change directions.

Q. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch (1500-mm) lengths of flexible duct clamped or strapped in place.

R. Connect flexible ducts to metal ducts with draw bands or adhesive plus sheet metal screws.

S. Install duct test holes where required for testing and balancing purposes.

T. 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

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
4. Motors

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 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.

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. 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.

D. Field quality-control reports.

E. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

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. 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.

1.6 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.

1.7 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Belts: One set(s) for each belt-driven unit.

PART 2 - PRODUCTS

2.1 UTILITY SET FANS

A. Basis-of-Design Product: Greenheck or comparable product by one of the following:
1. Loren Cook Company.
2. PennBarry.
3. Greenheck Fan Corp.

B. Housing: Fabricated of galvanized steel with side sheets fastened with a deep lock seam or welded to scroll sheets.

C. Housing Discharge Arrangement: Adjustable to eight standard positions.

D. Fan Wheels: Single-width, single inlet; welded to cast-iron or cast-steel hub and spun-steel inlet cone, with hub keyed to shaft.

E. Retain wheel material and blade style in first two subparagraphs below. Some materials and styles are not available in all sizes.

F. Blade Materials: Steel.

G. Blade Type: Backward inclined.

H. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.

I. Shaft Bearings: Prelubricated and sealed, self-aligning, pillow-block-type ball bearings with ABMA 9, L50 of 200,000 hours.
   1. Extend grease fitting to accessible location outside of unit.

J. Belt Drives:
   1. Factory mounted, with final alignment and belt adjustment made after installation
   2. Service Factor Based on Fan Motor Size: 1.5.

K. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.

L. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.

M. Belt Guards: Fabricate of steel for motors mounted on outside of fan cabinet.

N. 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.

2.2 CENTRIFUGAL ROOF VENTILATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:
1. Loren Cook Company.
2. PennBarry.
3. Greenheck Fan Cooperation

C. Housing: Removable, spun-aluminum, dome top and outlet baffle, one-piece, aluminum base with venturi inlet cone.
1. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.

D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

E. 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.

F. Accessories:
1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
2. Bird Screens: Removable, 1/2-inch (13-mm) mesh, aluminum, or brass wire.
3. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.

G. 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.
1. Configuration: Built-in cant and mounting flange.
2. Overall Height: 8 inches (200 mm).
3. Pitch Mounting: Manufacture curb for roof slope.
4. Metal Liner: Galvanized steel.

2.3 IN-LINE CENTRIFUGAL FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:
   1. Greenheck Fan Corporation.
   2. Loren Cook Company.
   3. PennBarry.

C. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

D. Direct-Drive Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing; with wheel, inlet cone, and motor on swing-out service door.

E. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.

F. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.

G. Accessories:
   1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
   2. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
   3. Companion Flanges: For inlet and outlet duct connections.
   4. Fan Guards: 1/2- by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
   5. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

2.4 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
   1. Motor Sizes: Minimum size as indicated. If not indicated, large enough for driven load will not require motor to operate in service factor range above 1.0.
   2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

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. Vibration- and seismic-control devices are specified in Division 23 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 roof-mounted units to curbs with cadmium-plated hardware.

D. Install units with clearances for service and maintenance.

E. Label units according to requirements specified in Division 23 Section 230553 "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section 233300 "Air Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Division 26 Section 260526 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 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 Division 23 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

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. Rectangular and square ceiling diffusers.
2. Perforated diffusers.
3. Louver face diffusers.
4. Modular core supply grilles.
5. Adjustable bar registers, grilles, registers, and grilles.
6. Fixed face registers, grilles, registers, and grilles.

B. Related Sections:
1. Section 089119 "Fixed Louvers" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
2. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 ACTION 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. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.

C. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.

3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.
6. Source quality-control reports.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

A. Rectangular and Square Ceiling Diffusers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Hart & Cooley Inc.
   b. Krueger.
   c. Price Industries.
   d. Titus.
   e. Tuttle & Bailey.
   f. Or approved equal
2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Steel or Aluminum where required.
4. Finish: Baked enamel, white.
5. Face Size: 24 by 24 inches (600 by 600 mm).
6. Face Style: Four cone.
7. Mounting: Surface and T-bar.
8. Pattern: Adjustable.
9. Dampers: Radial opposed blade.
10. Accessories:
   a. Equalizing grid.
   b. Plaster ring.
   c. Safety chain.
   d. Wire guard.
   e. Sectorizing baffles.
   f. Operating rod extension.

B. Perforated Diffuser:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Hart & Cooley Inc.
   b. Krueger.
   c. Price Industries.
   d. Titus.
   e. Tuttle & Bailey.
2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Steel backpan and pattern controllers, with steel or aluminum face where required.
4. Finish: Baked enamel, white.
5. Face Size: 24 by 12 inches (600 by 300 mm).
6. Duct Inlet: Round or Square.
7. Face Style: Flush.

8. Mounting: Surface or T-bar.
9. Pattern Controller: Four louvered deflector patches.
10. Dampers: Opposed blade.
11. Accessories:
    a. Equalizing grid.
    b. Plaster ring.
    c. Safety chain.
    d. Wire guard.
    e. Sectorizing baffles.
    f. Operating rod extension.

C. Louver Face Diffuser:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Price Industries.
    b. Titus.
    c. Tuttle & Bailey.
    d. Or approved equal
2. Devices shall be specifically designed for variable-air-volume flows.
3. Material: Steel or Aluminum where required.
4. Finish: Baked enamel, white.
5. Face Size: As indicated in drawings.
6. Mounting: Surface and T-bar Snap.
7. Pattern: Adjustable core style.
8. Dampers: Radial opposed blade.
9. Accessories:
    a. Square to round neck adaptor.
    b. Adjustable pattern vanes.
    c. Throw reducing vanes.
    d. Equalizing grid.
    e. Plaster ring.
    f. Safety chain.
    g. Wire guard.
    h. Sectorizing baffles.
    i. Operating rod extension.

2.2 HIGH-CAPACITY DIFFUSERS

A. Modular Core Supply Grilles:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Hart & Cooley Inc.
    b. Krueger.
    c. Price Industries.
    d. Titus.
    e. Tuttle & Bailey.
    f. Or approved equal
2. Throw: Extended distance for airflow rates.
3. Material: Steel.
4. Grilles per Unit: Four.
5. Finish: White baked acrylic.

6. Border: 1-1/2-inch (38-mm) width with countersunk screw holes.
7. Blades:
    a. Airfoil, individually adjustable horizontally.
    b. Double deflection.
    c. Set in modules.
8. Modules: Removable; rotatable.
9. Mounting: Surface.
10. Accessory: Opposed-blade steel damper.

2.3 REGISTERS AND GRILLES

A. Adjustable Bar Register:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Hart & Cooley Inc.
    b. Krueger.
    c. Price Industries.
    d. Titus.
    e. Tuttle & Bailey.
    f. Or approved equal
2. Material: Steel or Aluminum where required.
3. Finish: Baked enamel, white.
4. Face Blade Arrangement: Vertical spaced 1/2 inch (13 mm) apart.
5. Core Construction: Integral.
6. Rear-Blade Arrangement: Horizontal spaced 3/4 inch (19 mm) apart.
7. Frame: 1-1/4 inches (32 mm) 1 inch (25 mm) wide.
8. Mounting: Countersunk screw.
9. Damper Type: Adjustable opposed blade .
10. Accessories:
    a. Front-blade gang operator.
    b. Filter.

B. Adjustable Bar Grille:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Hart & Cooley Inc.
    b. Krueger.
    c. Price Industries.
    d. Titus.
    e. Tuttle & Bailey.
    f. Or approved equal
2. Material: Steel or Aluminum where required.
3. Finish: Baked enamel, white.
4. Face Blade Arrangement: Horizontal spaced 1/2 inch (13 mm) apart.
5. Core Construction: Integral.
6. Rear-Blade Arrangement: Horizontal spaced 3/4 inch (19 mm) apart.
7. Frame: 1-1/4 inches (32 mm) wide.
8. Mounting: Countersunk screw.

C. Fixed Face Register:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Hart & Cooley Inc.
   b. Krueger.
   c. Price Industries.
   d. Titus.
   e. Tuttle & Bailey.
   f. Or approved equal
2. Material: Steel or Aluminum where required.
3. Finish: Baked enamel, white.
4. Face Arrangement: Perforated core.
5. Core Construction: Integral.
6. Frame: 1-1/4 inches (32 mm) wide.
7. Mounting: Countersunk screw.
8. Damper Type: Adjustable opposed.
9. Accessory: Filter.

D. Fixed Face Grille:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Hart & Cooley Inc.
   b. Krueger.
   c. Price Industries.
   d. Titus.
   e. Tuttle & Bailey.
   f. Or approved equal
2. Material: Steel or Aluminum where required.
3. Finish: Baked enamel, white.
4. Face Arrangement: Perforated core.
5. Core Construction: Integral.
6. Frame: 1-1/4 inches (32 mm) wide.
7. Mounting: Countersunk screw.
8. Accessory: Filter.

2.4 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

SECTION 233723 – HVAC GRAVITY 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. Roof hoods.
   2. Goosenecks.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design ventilators, including comprehensive engineering analysis by a qualified professional engineer, using structural and seismic performance requirements and design criteria indicated.

B. Structural Performance: Ventilators shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of ventilator components, noise or metal fatigue caused by ventilator blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.
   1. Wind Loads: Determine loads based on pressures as indicated on Drawings.
   2. Wind Loads: Determine loads based on a uniform pressure of 30 lbf/sq. ft., acting inward or outward.

C. Seismic Performance: Ventilators, including attachments to other construction, 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."

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes, without buckling, opening of joints, overstressing of components, failure of connections, or other detrimental effects.
   1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

E. Water Entrainment: Limit water penetration through unit to comply with ASHRAE 62.1.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. For louvered-penthouse ventilators specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For gravity ventilators. Include plans, elevations, sections, details, ventilator attachments to curbs, and curb attachments to roof structure.
   1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.

C. Samples: For each exposed product and for each color and texture specified.

D. Samples for Initial Selection: For units with factory-applied color finishes.

E. Samples for Verification: For each type of louvered-penthouse ventilator indicated, in manufacturer's standard size.

F. Delegated-Design Submittal: For shop-fabricated ventilators indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   1. Detail fabrication and assembly of shop-fabricated ventilators.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof framing plans 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 roof curbs and ventilators will be attached.
   2. Sizes and locations of roof openings.

B. Seismic Qualification Certificates: For ventilators, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
   2. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.7 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5 or T-52.

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. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 zinc coating, mill phosphatized.

D. Stainless-Steel Sheet: ASTM A 666, Type 304, with No. 6 finish.

E. Fasteners: Same basic metal and alloy as fastened metal or 300 Series stainless steel unless otherwise indicated. Do not use metals that are incompatible with joined materials.
1. Use types and sizes to suit unit installation conditions.
2. Use Phillips flat or hex-head or Phillips pan-head screws for exposed fasteners unless otherwise indicated.

F. Post-Installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors made from stainless-steel components, with capability to sustain without failure a load equal to 4 times the loads imposed for concrete, or 6 times the load imposed for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.2 FABRICATION, GENERAL

A. Factory or shop fabricate gravity ventilators to minimize field splicing and assembly. Disassemble units to the minimum extent as necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.

B. Fabricate frames, including integral bases, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

C. Fabricate units with closely fitted joints and exposed connections accurately located and secured.

D. Fabricate supports, anchorages, and accessories required for complete assembly.

E. Perform shop welding by AWS-certified procedures and personnel.

2.3 ROOF HOODS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Carnes.
2. Greenheck Fan Corporation.

3. Loren Cook Company.

B. Factory or shop fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figures 6-6 and 6-7.

C. Materials: Galvanized-steel sheet, minimum 0.064-inch- thick base and 0.040-inch- thick hood or Aluminum sheet, minimum 0.063-inch- thick base and 0.050-inch- thick hood; suitably reinforced.

D. Roof Curbs: Galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch- thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to fit roof opening and ventilator base.
1. Configuration: Self-flashing without a cant strip, with; Built-in cant and; or Built-in raised cant and mounting flange.
2. Overall Height: 12 inches.

E. Bird Screening: Galvanized-steel, 1/2-inch- square mesh, 0.041-inch wire, Aluminum, 1/2-inch- square mesh, 0.063-inch wire, Flattened, expanded aluminum, 3/4 by 0.050 inch thick or Stainless-steel, 1/2-inch- square mesh, 0.047-inch wire.

F. Insect Screening: Aluminum, 18-by-16 mesh, 0.012-inch or Stainless-steel, 18-by-18 mesh, 0.009-inch wire.

G. Galvanized-Steel Sheet Finish:
1. Surface Preparation: Clean surfaces of dirt, grease, and other contaminants. Clean welds, mechanical connections, and abraded areas and repair galvanizing according to ASTM A 780. Apply a conversion coating suited to the organic coating to be applied over it.
2. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply an air-dried primer immediately after cleaning and pretreating.
3. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil for topcoat and an overall minimum dry film thickness of 2 mils.
a. Color and Gloss: As selected by Architect from manufacturer's full range.

H. Capacities and Characteristics:
1. Free Area: Not less than 7.0 sq. ft. for 48-inch- wide by 48-inch- high louver.
2. Air Performance: Not more than 0.10-inch wg static pressure drop at 600-fpm free-area exhaust or intake velocity.

2.4 GOOSENECKS

A. Factory or shop fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 6-5; with a minimum of 0.052-inch- thick, galvanized-steel sheet.

B. Roof Curbs: Galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch- thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to fit roof opening and ventilator base.
1. Configuration: Self-flashing without a cant strip, with; Built-in cant and; or Built-in raised cant and mounting flange.

2. Overall Height: 18 inches.

C. Bird Screening: Galvanized-steel, 1/2-inch- square mesh, 0.041-inch wire; Aluminum, 1/2-inch- square mesh, 0.063-inch wire; Flattened, expanded aluminum, 3/4 by 0.050 inch thick; or Stainless-steel, 1/2-inch- square mesh, 0.047-inch wire.

D. Insect Screening: Aluminum, 18-by-16 mesh, 0.012-inch or Stainless-steel, 18-by-18 mesh, 0.009-inch wire.

E. Galvanized-Steel Sheet Finish:
1. Surface Preparation: Clean surfaces of dirt, grease, and other contaminants. Clean welds, mechanical connections, and abraded areas and repair galvanizing according to ASTM A 780. Apply a conversion coating suited to the organic coating to be applied over it.
2. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply an air-dried primer immediately after cleaning and pretreating.
3. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil for topcoat and an overall minimum dry film thickness of 2 mils.
a. Color and Gloss: As selected by Architect from manufacturer's full range.

F. Capacities and Characteristics:
1. Free Area: Not less than 7.0 sq. ft. for 48-inch- wide by 48-inch- high louver.
2. Air Performance: Not more than 0.10-inch wg static pressure drop at 600-fpm free-area exhaust or intake velocity.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install gravity ventilators level, plumb, and at indicated alignment with adjacent work.

B. Install goosenecks on curb base where throat size exceeds 9 by 9 inches.

C. Install gravity ventilators with clearances for service and maintenance.

D. Install perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Install concealed gaskets, flashings, joint fillers, and insulation as installation progresses. Comply with Section 079200 "Joint Sealants" for sealants applied during installation.

F. Label gravity ventilators according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

G. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.

H. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in Section 233113 "Metal Ducts." Drawings indicate general arrangement of ducts and duct accessories.

3.3 ADJUSTING

A. Adjust damper linkages for proper damper operation.

END OF SECTION

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; see construction documents for location and size of each field connection.
   2. Wiring Diagrams: For power, signal, and control wiring.

C. Samples for Initial Selection: For units with factory-applied color finishes.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Warranty: Sample of special 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 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Filters: One set(s) for each air-handling unit.
   2. Gaskets: One set(s) for each access door.
   3. Fan Belts: One set(s) for each air-handling unit fan.

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. 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.

1.8 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.

1.9 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: One year(s) from date of Substantial Completion.
      c. For Labor: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. LG.
   2. Carrier.
   3. Or approved equal

2.2 GENERAL

A. The air-conditioning system shall use R32 refrigerant.

B. Each system should have one air source outdoor unit.

C. The outdoor unit shall be capable of operating at an elevation of 49.2 feet above or below the indoor unit.

D. The refrigerant circuit shall be field piped to a single matching indoor unit to control the heating or cooling operation of the system effectively and efficiently.

E. All refrigerant piping from outdoor unit to indoor unit shall be field insulated.

F. Factory installed microprocessor controls in the outdoor unit and indoor unit shall perform functions to efficiently operate the single zone system and communicate via minimum 18 AWG, 2-conductor, stranded, shielded or unshielded communication cable. If shielded, it must be grounded to chassis at ODU only.

G. Central control shall be available through a terminal connection on the outdoor unit.

H. The outdoor unit shall be internally assembled, wired, and piped from the factory.

I. The factory assembled system shall have the outdoor unit fitted with refrigerant strainer, check valves, oil separator, accumulator, 4-way reversing valve, electronic expansion valve, high side and low side refrigerant charging ports, and a service port.

J. The outdoor unit shall be capable of auto defrost operation to melt accumulated ice off the outdoor unit heat exchanger. The defrost cycle control shall be based on outdoor ambient temperatures and outdoor unit heat exchanger temperatures.

K. The outdoor units shall accommodate an optional drain pan heater.

L. The outdoor unit shall have an oil injection mechanism to ensure a consistent film of oil on all moving compressor parts at low speed.

M. The outdoor unit shall have an oil separator to separate oil mixed with the refrigerant gas during compression and return oil to the compressor.

2.3 INDOOR UNITS (5 TONS OR LESS)

A. Operating Conditions
1. The indoor unit shall be capable of the following ambient operating range.
a. Cooling: 57°F WB to 77°F WB.
b. Heating: 59°F DB to 81°F DB.

B. General
1. The unit shall be manufactured by LG or approved equal.
2. Unit shall be factory assembled, wired, piped, and run tested.
3. Unit shall be designed to be installed for indoor application.
4. The supply air opening shall be flanged for field installed ductwork that shall not exceed the external static pressure limitation of the unit.
5. The indoor units have sound ratings no higher than 38 dB(A) as tested per ISO Standard 3745.
6. Each indoor unit must be controlled with an LG MultiSite CRC2+ Remote Controller (or approved equal).
a. Model Number: PREMTBCV3.
7. Each indoor unit must include an LG Dry Contact kit to integrate the IDU with its respective OA damper (or approved equal).
a. Model Number: PDRYCB100.

C. Casing/Panel
1. Unit case shall be manufactured using galvanized steel plate.
2. The cold surfaces of the unit shall be covered internally with a coated polystyrene insulating material.
3. Unit shall be provided with hanger brackets designed to support the unit weight on four corners.
4. Hanger brackets shall have pre-punched holes designed to accept field supplied, all thread rod hangers.

D. Cabinet Assembly
1. Unit shall have supply air discharge outlet horizontally and a return air inlet horizontal.
2. Unit shall be equipped with factory installed temperature thermistors for:
a. Return air.
b. Refrigerant entering coil.
c. Refrigerant leaving coil.
3. Unit shall have a built-in control panel to communicate with the outdoor unit.
4. Unit shall have the following functions as standard:
a. Self-diagnostic function.
b. Auto restart function.
c. Auto changeover function.
d. Dehumidifying function.
e. Child lock function.
f. Dual thermistor control.
g. Hot Start.
h. Sleep Mode.

E. Fan Assembly
1. The unit shall have a direct drive Sirocco fan.

2. The fan shall be made of high strength ABS HT-700 polymeric resin.
3. The fan motor shall be Brushless Digitally controlled (BLDC) with permanently lubricated and sealed ball bearings.
4. The fan/motor assembly shall be mounted on vibration attenuating rubber grommets.
5. The fan speed shall be controlled using a microprocessor based direct digitally controlled algorithm.
6. In cooling mode, the indoor fan shall have the following settings: Low, Med, High, and Auto.
7. In heating mode, the indoor fan shall have the following settings: Low, Med, High, and Auto.
8. The Auto fan setting shall adjust the fan speed to achieve the set-point most effectively.
9. Each of the settings can be field adjusted from the factory setting (RPM/ESP).
10. The unit shall be designed to deliver published airflow up to 0.59 inches water gauge.

F. Filter Assembly
1. The return air inlet shall have a factory supplied removable, washable filter.
2. The filter access shall be from the rear of the unit.

G. Coil Assembly
1. Unit shall have a factory-built coil comprised of aluminum fins mechanically bonded on copper tubing.
2. Unit shall have minimum of 2 rows of coils.
3. Unit shall have a factory supplied condensate drain pan below the coil.
4. Unit shall have an installed and wired condensate drain pump capable of providing minimum 27.5-inch lift from bottom surface of the unit.
5. The drain pump shall have a safety switch to shut off the unit if condensate rises too high in the drain pan.
6. Unit shall have provision of 45° flare refrigerant pipe connections.
7. The coil shall be factory pressure tested at a minimum of 626 psig.
8. All refrigerant piping from outdoor unit to indoor unit shall be field insulated.

H. Microprocessor Control
1. The unit shall have a factory installed microprocessor controller capable of performing functions necessary to operate the system.
2. The unit shall be able to communicate with the outdoor unit using a field supplied minimum of 18 AWG, 2-conductor, stranded, shielded or unshielded communication cable. If shielded, it must be grounded to chassis at ODU only.
3. Central control shall be available through a terminal connection on the outdoor unit.
4. Group control shall be available to allow multiple indoor units to operate from a single controller or allow connection of more than one controller to an indoor unit.
5. The unit shall be able to operate with the fan turned off during system cooling thermal off.
6. The unit shall be able to operate with a continuous fan setting.
7. The unit controls shall operate the indoor unit using one of the five operating modes:
    a. Auto changeover.

b. Heating.
c. Cooling.
d. Dry.
e. Fan only.

I. Electrical
1. The unit electrical power shall be 208-230/1/60 (V/Ph/Hz).
2. The unit shall be capable of operating within voltage limits of +/- 10% of the rated voltage.

J. Controls
1. The indoor unit shall use controls provided by the manufacturer to perform all functions necessary to operate the system effectively and efficiently.
2. An optional wireless handheld controller shall be available as an additional accessory for use with installed LG wired controller.
3. An optional dry contact shall be available as an additional accessory.
4. The indoor unit shall accommodate an optional Wi-Fi module as an additional accessory to allow monitoring and control through a smart device with the LG Smart ThinQ© application.
5. The indoor unit shall have a factory installed R32 refrigerant leak detection sensor designed to communicate with mitigation devices and 3rd party alarms and transmit a system error code upon detection of a refrigerant leak or sensor failure/expiration.
6. An optional single-port shutoff valve shall be available as an additional accessory. The shutoff valve shall be designed to integrate with and respond to a signal from a connected R32 refrigerant leak detection sensor, to close the refrigerant valve upon receiving a signal that a refrigerant leak has been detected, or that the sensor has incurred a failure or reached its 10-year expiration date.

K. 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 206/110.
3. Fan: Direct drive, centrifugal.
4. 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. Retain first subparagraph below if enclosure is not open-dripproof type. Retain second subparagraph for premium efficiency.
   d. Enclosure Type: Totally enclosed, fan cooled.
   e. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
   f. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
   g. Mount unit-mounted disconnect switches on exterior of unit.
5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

6. Condensate Drain Pans:
   a. Fabricated with two percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
      1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
      2) Depth: A minimum of 1 inch deep.
   b. Double-wall, thermo plastic sheet with space between walls filled with foam insulation and moisture-tight seal.
   c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on both ends of pan.
      1) Minimum Connection Size: NPS 1
   d. Pan-Top Surface Coating: Asphaltic waterproofing compound.
7. Air Filtration Section:
   a. General Requirements for Air Filtration Section:
      1) Comply with NFPA 90A.
      2) Minimum Arrestance: According to ASHRAE 52.1 and MERV according to ASHRAE 52.2.
      3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
   b. Disposable Panel Filters:
      1) Factory-fabricated, viscous-coated, flat-panel type.
      2) Thickness: 1 inch or 2 inches.
      3) Arrestance according to ASHRAE 52.1: 80.
      4) Merv according to ASHRAE 52.2: 5.
      5) Media: Interlaced glass fibers sprayed with nonflammable adhesive and antimicrobial agent.
      6) Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.
   c. Extended-Surface, Disposable Panel Filters:
      1) Factory-fabricated, dry, extended-surface type.
      2) Thickness: 1 inch or 2 inches.
      3) Arrestance according to ASHRAE 52.1: 90.
      4) Merv according to ASHRAE 52.2: 7.
      5) Media: Fibrous material formed into deep-V-shaped pleats with antimicrobial agent and held by self-supporting wire grid.
      6) Media-Grid Frame: Nonflammable cardboard, Galvanized steel or Fire-retardant, 3/4-inch particleboard with gaskets.
      7) Mounting Frames: Welded, galvanized steel, with gaskets and fasteners; suitable for bolting together into built-up filter banks.

2.4 OUTDOOR UNITS (5 TONS OR LESS)

A. Air-Cooled, Compressor-Condenser Components:
   1. Casing:
      a. The outdoor unit cabinet shall be made of pre-coated metal (PCM).
      b. The front/side panels of the outdoor unit shall be removable for access to internal components.

c. The outdoor unit cabinet shall be tested in accordance with ASTM B-117 salt spray test procedure for a minimum of 1000 hours.

2. Outdoor Coil:
   a. The outdoor unit shall have a factory-built coil comprised of aluminum fins mechanically bonded to copper tubing.
   b. Coil coating shall be tested in accordance with ASTM B-117 salt spray test procedure for a minimum of 10,000 hours.
   c. The outdoor unit coil shall be factory tested to a pressure of 626 psig.
   d. The coil for each outdoor unit shall have a minimum of 14 Fins per Inch (FPI).
   e. The coil for each outdoor unit shall have a 2-row heat exchanger.
   f. The outdoor unit cabinet shall have a coil guard.
3. Compressor (s):
   a. The outdoor unit(s) shall be equipped with one hermetically sealed, digitally controlled, inverter driven twin-rotary compressor.
   b. The outdoor unit(s) should be equipped with one hermetically sealed, digitally controlled, inverter driven R1 scroll compressor.
   c. The inverter driven, digitally controlled compressor shall be capable of operating in a frequency range from 10 Hz to 100 Hz, with control in 1 Hz increments.
   d. The inverter driven, digitally controlled compressor shall be capable of operating in a frequency range from 15 Hz to 100Hz, with control in 1 Hz increments.
   e. The inverter driven, digitally controlled compressor shall be capable of operating in a frequency range from 10 Hz to 135Hz, with control in 1 Hz increments.
   f. The compressor shall be mounted on vibration attenuating rubber grommets.
   g. The compressor shall use a factory charge of Polyvinyl Ether (PVE) oil.
   h. The compressor bearing(s) shall have Teflon™ coating.
   i. The compressor shall be equipped with over-current protection.
   j. Fixed speed, non-inverter driven compressors shall not be permitted.
4. Heat-Pump Components:
   a. Reversing valve and low-temperature-air cutoff thermostat.
5. Fan:
   a. Each 3/4-to-2.5-ton outdoor unit shall be equipped with one direct drive variable speed propeller fan with Brushless Digitally Controlled (BLDC) motor with a horizontal discharge.
   b. Each 3-to-5-ton outdoor unit shall be equipped with two direct drive variable speed propeller fans with BLDC motors with a horizontal air discharge.
   c. The fan blades shall be made of Acrylonitrile Butadiene Styrene (ABS) material.
   d. The fan(s) shall be equipped with permanently lubricated bearings.
   e. The fan motor(s) shall have variable speed to a maximum of 850 RPM, or 750 RPM.
   f. The fan(s) should have a raised guard to help prevent contact with moving parts.
6. Motor:
   a. Permanently lubricated, with integral thermal-overload protection.
7. Low Ambient Kit:
   a. Permits operation down to 35 deg F.
8. Mounting Base:

a. Polyethylene.

9. Sound Levels:
   a. The compressor(s) shall be wrapped with heat resistant foil faced, sound deadening blanket that covers all exposed surfaces of the compressor. Sound deadening blankets shall be secured in place by use of a Velcro™ tool-less joint sealing system with a minimum of ½" of overlap along all seams. The sound deadening compressor blanket shall be engineered to leave no direct sound path between the outer surface of the body of the compressor and the surrounding environment.
   b. The outdoor unit shall have sound levels not exceeding 56 dB(A) tested in an anechoic chamber under ISO 3745 standard.
   c. A field setting shall be available to program the outdoor unit to reduce sound levels at night, when desired, to a selectable level while still able to meet building load requirements. This mode is available during cooling operation.
10. Sensors:
   a. The outdoor unit shall have:
      1) Suction temperature sensor.
      2) Discharge temperature sensor.
      3) High pressure sensor.
      4) Low Pressure sensor.
      5) Outdoor ambient temperature sensor.
      6) Outdoor unit heat exchanger temperature sensor.

2.5 ACCESSORIES

A. Control equipment and sequence of operation are specified in Section 230900 "Instrumentation and Control for HVAC."

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.

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 061000 “Rough Carpentry." Anchor units to supports with removable, cadmium-plated fasteners.

D. Equipment Mounting:
1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s).
2. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

E. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

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.

C. Duct Connections: Duct installation requirements are specified in Section 233113 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect outside air ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Section 233300 "Air Duct Accessories."

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

SECTION 260010 – SUPPLEMENTAL REQUIREMENTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies supplemental requirements generally applicable to the Contract Work specified in Division 26. This Section is also referenced by related Work specified in other Divisions.

B. Related Requirements:
   1. The general conditions and Division 1 are part of this section and apply to this section as fully as if repeated herein. This section, 260010, applies to all Division 26 categories.

1.2 CONSTRUCTION DOCUMENT INTENT

A. These construction documents are intended to be diagrammatic and reflect the scope, quality, and character of the work to be performed; all miscellaneous materials and work required for a complete and operational system, though not specifically mentioned, shall be furnished, and installed by the Contractor.

B. Equipment shown to scale is approximate only and based upon a general class of equipment specified. The Contractor shall confirm sizes, dimensions, weights and locations of all devices, light fixtures, and equipment prior to installation. Dimensioned architectural drawings shall take precedence over diagrammatic layouts shown on these contract documents.

C. The specifications and the drawings are an integral document and shall be considered complementary to each other. In the case of a conflict between the specifications and the drawings, the more constricting condition shall be enforced.

D. The Contractor shall be responsible for reporting any discrepancies, errors, or omissions noted prior to bid.

E. It is the intent of the drawings to indicate schematic routing and placement of devices, fixtures, equipment and conduit. Equipment or devices requiring a precise location shall be dimensioned on other trade documents (architectural, mechanical, etc.). Offsets, elbows, or extensions shall be furnished and installed by the Contractor as necessary to avoid structure, piping, and clearances and to provide a complete and workmanlike installation.

1.3 QUALITY ASSURANCE

A. All work, materials and equipment shall comply with the latest versions of the codes, ordinances and regulations enforced by the local government having jurisdiction,

including the regulations of serving utilities and any participating government agencies having jurisdiction.

B. Comply with the latest editions of applicable codes, ordinances, regulations and standards of:
   1. Americans with Disabilities Act (ADA)
   2. Insulated Cable Engineers Association (ICEA).
   3. Institute of Electrical and Electronics Engineers (IEEE).
   4. National Electrical Manufacturers Association (NEMA).
   5. American National Standards Institute (ANSI).
   6. National Bureau of Standards (NBS).
   7. Certified Ballast Manufacturers (CBM).
   8. American Society for Testing and Materials (ASTM).
   9. Underwriter's Laboratories (UL).
   10. California Code of Regulations (Titles 8, 19, 22, 24).
   11. California Building Code (CBC).
   12. California Electrical Code (CEC).
   13. National Electrical Safety Code (NECS).
   14. National Electrical Testing Agency (NETA).
   15. National Electrical Contractor's Association (NECA).
   16. National Fire Protection Association (NFPA)

C. All materials and equipment shall be listed by and shall bear the label of an approved Nationally Recognized Testing Laboratory (NRTL) as approved by the authority having jurisdiction. If none of the approved electrical testing laboratories has published standards for a particular item, then other national independent testing standards, if available, applicable, and approved by the authority having jurisdiction, shall apply and such items shall bear those labels. Where one of the approved electrical testing laboratories has an applicable system listing and label, the entire system shall be so labeled.

D. Where requirements differ, the more stringent shall apply.

1.4 CONTINUITY OF POWER

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions:
   1. Notify Owner no fewer than fourteen (14) days in advance of proposed interruption of electrical service.
   2. Do not proceed with interruption of electrical service without Owner's written permission.
   3. Coordinate interruption with systems impacted by outage including, but not limited to, the following:
      a. Exercising generators.
      b. Emergency lighting.
      c. Elevators.
      d. Fire-alarm systems.

B. Temporary electrical power shall be the responsibility of the Contractor.

1.5 SUBMITTALS

A. Submittals shall be furnished by Contractor for each device, equipment, conduits, conductors and cables, light fixtures, and lighting controls intended to be used on the project. Submit material list within 2 weeks of Notice to Proceed and obtain review, prior to submission of manufacturer's data and shop drawings.

B. All materials shown shall be new, of prime quality, and listed as suitable for the application. Materials shall be currently in production and shall be supported by spare parts, repair service, maintenance and factory technical support. Materials of one assembly (switchboards, substations, panelboards, etc.) shall be of one manufacturer unless noted otherwise in the construction documents.

C. Piecemeal submittals will not be accepted. Incomplete submittals will be rejected at the discretion of the reviewing Engineer. Submit in brochure form with all listings referenced to applicable sections and paragraphs in the specifications. Listing items "as specified" without both name of manufacturer and model number or type (designation) is not acceptable.

D. Contractor shall submit a complete list of materials and equipment proposed for the project including which is exactly as specified. List to contain only one (1) manufacturer's name and reference to applicable sections and paragraphs of the specifications. List shall be submitted within two (2) weeks of issue of Notice to Proceed. Any material or equipment installed without written approval shall be subject to immediate removal.

E. Submittal brochures shall be complete and descriptive of the type, make, manufacturer, application, quantity, performance, capacity, ratings, options, dimensions, clearances, weights, nameplate data, special installation requirements, mounting method, NEMA type, NEMA class, environmental restrictions, layout requirements or other information as may be necessary for review of the material.

F. Submittal brochures for switchboards (or switchgear, if applicable) shall include, as a minimum, the following: single-line diagrams; fault current ratings of buses and devices; device identification, ratings, layout and characteristics; dimensions; circuit identification; identification label type and method of affixing; mounting; conduit entry point and quantities; NEMA enclosure type; and additional data as required for a complete review.

G. Submittal brochures for lighting systems shall include, as a minimum, the following: manufacturer; detailed drawing or photograph; dimensions; lamp data; ballast/driver data; certified photometric data from a third-party testing agency; NRTL label listing; fixture number or identification from the drawings; finish color and material; mounting equipment; socket type and rating; environmental ratings (damp location, watertight, explosion-proof, etc.); voltage; input wattage; and additional information as necessary for a complete review.

H. The Contractor shall be responsible for all aspects of substitutions of material including any additional cost or delay incurred as a result of the substitution. The Contractor shall coordinate all substitutions with other trades, verify code compliance, verify clearances, photometric performance, appearance, suitability, constructability, and

availability of the material prior to submitting the substitution for review. The Contractor shall bear the responsibility of any increased costs to other trades which are directly related to the substitution.

1.6 EXISTING CONDITIONS

A. The contractor shall verify all existing conditions prior to bid and include all costs associated with the existing conditions in the bid. The Contractor shall match the finish and appearance of all existing conditions where construction of new work is adjacent to existing surfaces or equipment.

B. Coordinate work to be performed in occupied areas and comply with the Owner's requirements such that the Owner's work or ongoing activities are not disrupted by the Contractor. Verify the need for work to be performed during premium hours, evenings, weekends, or holidays prior to bid and include all costs in bid. Bring to the Owner's attention the need and locations for all disruptive work prior to commencement of work.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 INSTALLATION

A. The contractor shall arrange for the sequence of construction including the scheduling of long-lead items, expected shutdowns, work of other trades and Owner-scheduled events. The contractor shall coordinate and cooperate with all other trades for a successful completion of the Contract Work.

B. The contractor shall provide adequate and qualified supervision for the work performed and at no point during the construction shall work be performed without the supervision of a representative of the Contractor.

C. The drawings show general arrangement of equipment and appurtenances. Follow these drawings as closely as the actual construction will permit. Provide all offsets, fittings, and appurtenances required but not shown on drawings.

D. All equipment shall be installed plumb and level, orthogonal or parallel to structure and in a professional and skillful manner. All equipment and junction boxes shall be accessible for maintenance, inspection and replacement.

E. The locations of fixtures, outlets, devices, equipment, etc. indicated on drawings are approximate location only. Verify location and mounting height of outlets/equipment not dimensionally shown on the plans with Architect prior to rough-in. Revision and coordination may be necessary at the time the equipment is installed in order to meet field conditions or other coordination.

F. Coordinate all equipment points of connection, including voltage, wiring installation method, fuse and overcurrent protection, etc. with equipment vendor. The Contractor shall notify the Engineer of any discrepancies immediately.

G. Coordinate the placement and sequence of installation for all mounting bolts, conduits, sleeves, etc. that are to be installed in cast-in-situ concrete slabs, concrete walls, and post-tension concrete slabs with the structural drawings prior to rough-in.

H. Coordinate locations of all penetrations, openings, slots, chases, and sleeves as necessary for the installation of raceways, conductors and equipment. The Contractor shall install access panels in walls or ceilings in coordination with the Architect for all electrical boxes and equipment requiring access. The Contractor shall provide approved fire sealant where required to maintain fire ratings at all penetrations.

I. Coordinate location of light fixtures, disconnect switches, and controllers in mechanical equipment rooms with other trades contractors prior to installation to avoid any conflicts and to be in compliance with code. Maintain proper mounting heights and clearances.

J. Examine and compare the contract drawings with contract specifications and report any discrepancies to Architect and Engineer.

3.2 SEISMIC ANCHORAGE

A. All switchgear and other free standing electrical equipment shall be anchored to withstand seismic forces in this area.

B. Wall mounted equipment shall be anchored/braced to withstand seismic force.

C. Conduit supports shall be adequately sized and braced to comply with seismic criteria.

3.3 START UP AND COMMISSIONING

A. Contractor shall be responsible to provide manufacturer's technician for startup service of each system as indicated. The Contractor shall demonstrate that all systems operate within the manufacturer's recommended performance characteristics, the electrical construction documents, system requirements, and Owner requirements.

B. The Contractor shall initiate start up of all electrical equipment including operation of all devices, switches, generators, transfer switches, overcurrent protection, disconnect switches, etc. to verify normal operation of all moving parts and electrical performance.

C. The Contractor shall test, adjust, aim, align, label, clean and complete all systems prior to acceptance by the Owner's Representative.

D. The Contractor shall test each system per the manufacturer's requirements and shall perform the following system tests:
   1. Inspect cables for physical damage and proper connection.

2. Torque test cable connection and tighten in accordance with termination manufacturers recommendations.
3. Insulation resistance test of each cable.
4. Inspect ground system connections.
5. Voltage drop tests on the main grounding electrode of system.
6. Determine the ground resistance between the main grounding system and all major electrical equipment frames, system neutral points.
7. Check rated voltage and phase balance at all equipment, motors and selected devices at full load conditions. Measure no load voltage conditions at each location.
8. Furnish all material, equipment, instruments and labor as required to complete testing.
9. Provide all test results properly bound in PDF format.

3.4 INSTRUCTION MANUAL AND TRAINING

A. Operating instructions shall be provided by the Contractor at the conclusion of the project for each system and each principal piece of equipment for the use of operating and maintenance personnel. The operating instructions shall include wiring and control diagrams showing the entire system, including, but not limited to, equipment, devices, and control sequences. All operating instructions shall be approved by the University's Representative.

B. The Contractor shall provide the operation and maintenance manuals to the Owner's Representative at the completion of the project, O&M manuals may be submitted in PDF format. Each manual shall be labeled indicating: the project name; system name; Contractor's name, telephone number, and contact person; and Owner's name. The Contractor shall provide the following minimum information within each manual:
   1. List of the Subcontractors performing work on the system including contact names, telephone numbers, and email addresses.
   2. Routine and emergency service contact names, telephone numbers, and email addresses for each system.
   3. Description of system operation.
   4. Single line diagrams and control wiring diagrams.
   5. Detailed product literature with technical information.
   6. Local factory representative contact name, telephone number, and email address.
   7. Sequence of starting, shutdown and operation.
   8. Installation instructions and safety requirements.
   9. Maintenance schedule, testing instructions and performance parameters.
   10. Parts list including recommended spare parts.

C. Include Automatic operation of the emergency system gear, switchgear and/or subsystem including required component settings (e.g. automatic transfer, medium voltage switchgear, etc.). Include operation of the switchgear and/or subsystems, and any emergency operation capability and procedures.

D. Safety features built into the switchgear and/or subsystem.

E. Start-up, checkout and shutdown procedures.

F. Shop Drawing Manual: Complete set of record shop drawings, cut sheets and brochures.

G. Owner's staff and maintenance personnel shall be thoroughly trained, minimum four (4) hours, in the use of each system or major piece of equipment installed unless otherwise stated in other sections of Division 26. This training shall be provided as part of the Contractor's base bid to supply the system or equipment. Refer to other sections of Division 26 for additional information. The training is to be scheduled at mutually agreeable times between the Owner's Representative and the Contractor.

3.5 CLEANING AND REPAIR

A. The Contractor shall provide cutting and patching as required to install the electrical system in this contract. Patching shall be performed with materials which exactly match the adjacent surfaces in color, texture, character, and appearance. All patches must maintain the fire ratings of the original surface and shall be sealed with a U.L. listed and Fire Marshal approved sealant.

B. The Contractor shall match the finish and appearance of all existing conditions where construction of new work is adjacent to existing surfaces or equipment. The Contractor shall protect all surfaces, structure, furnishings, and finishes not directly affected by cutting or patching. Provide dust and moisture barriers as required during cutting and prior to patching openings.

C. Vacuum clean the interiors of all switchboards, substations, panelboards, transformers, motor control centers and transfer switches upon completion of all work to remove dust and debris. After cleaning, cover all equipment to prevent any construction dust from recurring. Before equipment is energized, vacuum all interiors a second time to assure clean equipment.

END OF SECTION

SECTION 260513 – MEDIUM-VOLTAGE CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Cables.
2. Connectors.
3. Separable insulated connectors.
4. Medium-voltage tapes.
5. Arc-proofing materials.

B. Related Requirements:
1. The general conditions, Division 1, and Section 260010 "Supplemental Requirements for Electrical" are part of this section and the contract for this work. All specifications provided apply to this section as fully as if repeated herein.

1.2 SUBMITTALS

A. Product Data: For each type of cable. Include terminations for cables and cable accessories, fireproofing and glass cloth tape. Include manufacturer's complete technical data indicating cable construction, shielding, insulation material, thickness of insulation, jacket, cable stranding, and voltage rating of each type of cable specified, splices and terminations. Indicate place and date of manufacture for each cable, cable accessory, splice, and termination.

B. Terminations: Include 20 year warranty with product data submittal.

C. Qualification Data: For installer, cable splicer and terminator, testing agency. Submit complete documents for approval by Owner's Representative. Documents shall include the names, qualifications, experience; training certificates of each person intended to perform the splicing, termination and field testing of medium voltage cables approved for installation.

D. Material Certificates: from the manufacturer for each type of cable, splice, termination, and accessory.

E. Source quality-control reports:
1. Source quality-control reports: Sample test on insulation. Test shall be done at the factory to verify physical properties, heat distortion, and accelerated water absorption in accordance with ICEA S-93-639.
2. Factory Tests: Complete tests shall be done on each length of cable at the cable by the manufacturer's trained testing engineer/technician at the manufacturer's testing facility at the factory in accordance with ICEA S-93-639, and UL-1072. Tests shall include Insulation resistance, power factor, corona level, AC dielectric. Corona test shall be done per AEIC CS8; Section E. Recordings of the tests shall be made on X-Y graph.

3. Furnish six (6) copies (or electronic copy) of the certified factory test reports to the Owner's Representative complete with X-Y recordings showing the corona test results for review two weeks prior to shipment of cables. Test Report shall include the results of the tests, cable identification, reel number, factory order number, cable length and all cable specifications. Each test report shall be signed by the manufacturer's testing engineer and include the name of the testing engineer/technician, location, and date of testing.
4. Submit test reports minimum two (2) weeks prior to shipment of cables to the job site. Cable shall not be installed in any duct or conduit until related all test reports have been reviewed and accepted by Owner's Representative.

F. Field quality-control reports. Perform field testing of cables per paragraph 3.2. Submit field test report to Owner's representative within two (2) weeks of completion of test.

G. Cable Pull Tension: Under separate submission, the contractor shall submit cable pulling criteria and calculations for approval prior to work. Include cable pull tension reports from the cable manufacturer.

1.3 QUALITY ASSURANCE

A. Contractor shall use American made cables. Obtain cables and accessories from a single source from a single manufacturer.

B. The manufacturer shall have a minimum of fifteen (15) years of experience in manufacturing medium voltage EPR power cables and shall submit a certified copy of its AEIC CS 8 qualification.

C. Manufacturer shall have ISO 9001 Certification. The cable manufacturer shall compound the insulation in its own facility using a closed system to ensure maximum cleanliness. The complete cable shall be manufactured in same manufacturer's facility.

D. Testing: Provide services of a qualified independent testing laboratory to perform the specified field tests. Notify the Owner's Representative fourteen (14) days in advance of performance of work requiring testing.

E. Cables, splices, and terminations shall be manufactured within twelve (12) months of installation. Each item shall have a permanent marking on the product or the original manufacturers' package indicating the date and place of manufacture unless otherwise noted. Cables shall have the dates marked on the outer jacket.

F. Cable including insulation, shielding tape shall be clean with smooth surface and does not have any surface abnormalities or ridges.

G. Installer: Each installer, splicer and terminator shall have minimum ten (10) years' recent experience in installation, splicing and terminating of medium voltage cables similar to those specified on this project. Splicers shall be located within forty (40) miles radius of the project. Contractor shall engage cable splicers and terminators, trained, and certified by splice/termination material manufacturer, to install, splice, and terminate medium-voltage cable of type and rating specified on this project. Training and certification shall be within the last three (3) years from the date of installation. Provide references of minimum three projects of similar size and type of splices and

terminations, completed within the last three years. Include project contacts information.

H. Testing Agency Qualifications:
1. Comply with section "Supplemental Requirements for Electrical."
2. Field Supervisor shall have minimum ten (10) years' experience and Field Testing Technician shall have a minimum of seven (7) years' experience in field testing of medium voltage cables of the type and rating similar to the cables to be tested on this project.

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. Comply with IEEE C2 and NFPA 70.

C. Source Limitations: Obtain cables and accessories from single source from single manufacturer.

2.2 CABLES

A. Manufacturers: subject to compliance with requirements, provide products by one of the following manufacturers:
1. The Okonite Company
2. Southwire
3. Prysmian Group (General Cable Technologies Corporation)
4. Or Equal

B. Cable Type: Type MV 105; 500MCM or other sizes as indicated on drawings.
1. Suitable for installation in conduit, subject to alternately wet and dry conditions.
2. To operate satisfactorily, both electrically and mechanically, at conductor temperatures not exceed 105°C continuous for normal loading; 140°C for emergency loading, emergency of 36 hours, 250°C for short circuit loading assuming short circuit duration of two seconds. Emergency overload operation may occur for periods up to 100 hours per year and with as many as five (5) such 100 hour periods within the lifetime of the cable.

C. Conductor Insulation: Ethylene-propylene rubber (EPR). Insulation: High quality, ethylene-propylene base, thermosetting compound of high dielectric strength with heat, moisture, ozone, and corona resistant properties, homogenous, solid, and applied with good workmanship. Insulation thickness shall be 220 mils minimum average, and 200 mils minimum at any point; meet or exceed the latest editions of Standards ICEA S-93-639, AEIC CS-8 for 133 percent insulation level. EPR insulation compound shall be free from polyethylene or contain 5% or less polyethylene.
1. Voltage Rating: 15 kV.

2. Insulation Thickness: 133 percent insulation level.

D. Conductor: Copper.

E. Comply with UL 1072, AEIC CS8, ICEA S-93-639/NEMA WC 74, ICEA S-97-682, and ICEA S-94-649.

F. Conductor Stranding: Compact round, concentric lay, Class B.

G. Strand Shielding: Thermoset EPR based material or a material extruded over the conductors with thermal characteristics equal to or better than those of the insulation; chemically compatible with the conductor and the cable insulation; firmly and continuously bonded to the overlying insulation; easily removable from the conductors; not less than 20 mils (nominal) for compact round conductor, or more than 50 mils thick. Compatibility of material shall be demonstrated by laboratory test results.

H. Semi-Conducting Shield: Insulated conductor to have a suitable layer of semi-conducting, extruded, thermosetting, EPR shielding applied directly over the insulation; 32 mils (nominal) thickness; impervious to sunlight, the elements and acid or alkaline soils.

I. Construction: Strand shielding and semi-conducting insulation shield shall be applied in a continuous triple tandem extrusion process.

J. Shielding: Uncoated copper tape, helically applied over insulation .005 inch thick with minimum 25 percent overlap.

K. Cable Jacket: Sunlight-resistant PVC. Jacket shall be 80 mil, minimum average thickness polyvinyl chloride jacket extruded over the shielding tape; smooth, of uniform composition and free of holes, cracks, and imperfections; longitudinal shrinkage relative to the insulation less than five percent.

L. Identification: Provide durable lifetime identification printed, embossed, or engraved on outer surface of the jacket including manufacturer's name, month and year of manufacture, place of manufacture, conductor type and size, insulation thickness in mils, and the rated voltage, all on 3-foot center maximum spacing.

M. Sealing: Cable manufacturer shall seal ends of cable with mastic material and tight fitting plastic end cap to prevent entrance of moisture.

2.3 CONNECTORS

A. Manufacturers:
1. 3M; Electrical Markets Division.
2. G&W Electric Company.
3. Thomas & Betts Corporation/Elastimold
4. Tyco Electronics; Raychem Product
5. Or equal

B. Comply with ANSI C119.4 for connectors between aluminum conductors or for connections between aluminum to copper conductors.

C. Copper-Conductor Connectors: Copper barrel crimped connectors.

D. Grounding Connectors: Grounding connectors shall be of bronze type.

2.4 SEPARABLE INSULATED CONNECTORS

A. Manufacturers:
1. 3M; Electrical Markets Division.
2. G&W Electric Company.
3. Thomas & Betts Corporation/Elastimold
4. Tyco Electronics; Raychem Product
5. Or equal

B. Description: Modular system, complying with IEEE 386, with disconnecting, single-pole, cable terminators and with matching, stationary, plug-in, dead-front terminals designed for 15kV cable voltage and for sealing against moisture.

C. Terminations at Distribution Points: Modular type, consisting of terminators installed on cables and modular, dead-front, terminal junctions for interconnecting cables.

D. Dead-Break Cable Terminators: Elbow-type unit with 600 A continuous-current rating; designed for de-energized disconnecting and connecting; coordinated with insulation diameter, conductor size, and material of cable being terminated. Include test point on terminator body that is capacitance coupled.
1. 15kV modular cable splices shall consist of a 600 amperes separable insulated connectors "T-Bolt" system rated for continuous operation at 15 KV for single-conductor shielded power cables. The system components shall be designed according to the specifications listed in ANSI/IEEE Standard 386-1985 for 15 KV 600 amp dead-break interfaces.
2. The system shall be made up of specific kits designed for splicing, tapping (adding-on) dead-ending, and 600 amp equipment connecting. Each kit shall contain all the components necessary for its intended application. The connector cable sizing adapter and shield adapter shall be contained in a separate adapter kit. The system shall be capable of making dead-end, 2 way, 3-way, or multiple tap splices, and of making connections to 15 KV 600 amp apparatus bushings.

E. Dead-Front Terminal Junctions: Modular bracket-mounted groups of dead-front stationary terminals that mate and match with above cable terminators. Two-, three-, or four-terminal units as indicated, with fully rated, insulated, watertight conductor connection between terminals and complete with grounding lug, manufacturer's standard accessory stands, stainless steel mounting brackets, and attaching hardware.
1. Protective Cap: Insulating, electrostatic-shielding, water-sealing cap with drain wire.
2. Portable Feed-Through Accessory: Two-terminal, dead-front junction arranged for removable mounting on accessory stand of stationary terminal junction.
3. Grounding Kit: Jumpered elbows, portable feed-through accessory units, protective caps, test rods suitable for concurrently grounding three phases of feeders, and carrying case.

4. Standoff Insulator: Portable, single dead-front terminal for removable mounting on accessory stand of stationary terminal junction. Insulators suitable for fully insulated isolation of energized cable-elbow terminator.

F. Test-Point Fault Indicators: Applicable current-trip ratings and arranged for installation in test points of load-break separable connectors, and complete with self-resetting indicators capable of being installed with shotgun hot stick and tested with test tool.

G. Tool Set: Shotgun hot stick with energized terminal indicator, fault-indicator test tool, and carrying case.

2.5 MEDIUM-VOLTAGE TAPES

A. Manufacturers:
1. 3M; Electrical Markets Division.
2. Thomas & Betts Corporation/Elastimold
3. Tyco Electronics; Raychem Product
4. Or equal

B. Ethylene/propylene rubber-based, 30 mil (0.76 mm) splicing tape, rated for 130 deg C operation. Minimum 3/4 inch (20 mm) wide.

C. Silicone rubber-based, 12 mil (0.30 mm) self-fusing tape, rated for 130 deg C operation. Minimum 1-1/2 inch (38 mm) wide.

D. Insulating-putty, 125 mil (3.175 mm) elastic filler tape. Minimum 1-1/2 inch (38 mm) wide.

2.6 ARC-PROOFING MATERIALS

A. Manufacturers:
1. 3M; Electrical Markets Division.
2. Bishop
3. Or equal

B. Tape for First Course on Metal Objects: 10 mil (250 micrometer) thick, corrosion-protective, moisture-resistant, PVC pipe-wrapping tape.

C. Arc-Proofing Tape: Fireproof tape, flexible, conformable, intumescent to 0.3 inch (8 mm) thick, and compatible with cable jacket.

D. Glass-Cloth Tape: Pressure-sensitive adhesive type, 1 inch (25 mm) wide.

2.7 SOURCE QUALITY CONTROL

A. Test and inspect cables according to ICEA S-97-682 and ICEA S-94-649 before shipping.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cables according to IEEE 576.

B. Proof conduits prior to conductor installation by passing a wire brush mandrel and then a rubber duct swab through the conduit. Separate the wire brush and the rubber swab by 48 to 72 inch (1200 to 1800 mm) on the pull rope.
   1. Wire Brush Mandrel: Consists of a length of brush approximately the size of the conduit inner diameter with stiff steel bristles and an eye on each end for attaching the pull ropes. If an obstruction is felt, pull the brush back and forth repeatedly to break up the obstruction.
   2. Rubber Duct Swab: Consists of a series of rubber discs approximately the size of the conduit inner diameter on a length of steel cable with an eye on each end for attaching the pull ropes. Pull the rubber duct swab through the duct to extract loose debris from the duct.

C. Pull Conductors: Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
   1. Where necessary, use manufacturer-approved pulling compound or lubricant that does not deteriorate conductor or insulation.
   2. Use pulling means, including fish tape, cable, rope, and basket-weave cable grips, that do not damage cables and raceways. Do not use rope hitches for pulling attachment to cable.
   3. Use pull-in guides, cable feeders, and draw-in protectors as required to protect cables during installation.
   4. Do not pull cables with ends unsealed. Seal cable ends with rubber tape.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.

E. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

F. Install "buried-cable" warning tape 12 inch (305 mm) above cables.

G. In manholes, handholes, pull boxes, junction boxes, and cable vaults, train cables around walls by the longest route from entry to exit; support cables at intervals adequate to prevent sag.

H. Install sufficient cable length to remove cable ends under pulling grips. Remove length of conductor damaged during pulling.

I. Install terminations at ends of conductors, and seal multiconductor cable ends with standard kits.

J. Install separable insulated-connector components as follows:
   1. Protective Cap: At each terminal junction, with one on each terminal to which no feeder is indicated to be connected.

2. Portable Feed-Through Accessory: At each terminal junction, with one on each terminal.
3. Standoff Insulator: At each terminal junction, with one on each terminal.

K. Arc Proofing: Unless otherwise indicated, arc proof medium-voltage cable at locations not protected by conduit, cable tray, direct burial, or termination materials. In addition to arc-proofing tape manufacturer's written instructions, apply arc proofing as follows:
1. Clean cable sheath.
2. Wrap metallic cable components with 10 mil (250 micrometer) pipe-wrapping tape.
3. Smooth surface contours with electrical insulation putty.
4. Apply arc-proofing tape in one half-lapped layer with coated side toward cable.
5. Band arc-proofing tape with two layers of 1 inch (25 mm) wide half-lapped, adhesive, glass-cloth tape at each end of the arc-proof tape.

L. Seal around cables passing through fire-rated elements according to Section 078413 "Penetration Firestopping."

M. Ground shields of shielded cable at terminations, splices, and separable insulated connectors. Ground metal bodies of terminators, splices, cable and separable insulated-connector fittings, and hardware.

N. Ground shields of shielded cable at one point only. Maintain shield continuity and connections to metal connection hardware at all connection points.

O. Identify cables according to Section 260553 "Identification for Electrical Systems." Identify phase and circuit number of each conductor at each splice, termination, pull point, and junction box. Arrange identification so that it is unnecessary to move the cable or conductor to read the identification.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:
1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters.
2. After installing medium-voltage cables and before electrical circuitry has been energized, test for compliance with requirements.
3. Perform direct-current High Potential test of each new conductor according to NETA ATS, Ch. 7.3.3. Do not exceed cable manufacturer's recommended maximum test voltage.

B. Medium-voltage cables will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION

SECTION 260519 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Copper building wire.
2. Metal-clad cable, Type MC.
3. Connectors and splices.

B. Related Requirements:
1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260513 "Medium-Voltage Cables" for single-conductor and multiconductor cables, cable splices, and terminations for electrical distribution systems with 601 to 35 000 V.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data including catalog cut sheets for each type of product. Indicate each size and type to be used in the project.

B. Field test reports.

1.3 QUALITY ASSURANCE

A. Refer to section “Basic Materials and Methods” for additional requirements.

B. Source Limitations: Obtain conductors and cables through one source from a single manufacturer through a local distributor unless otherwise indicated. Comply with NFPA 70.

C. All Conductors and cables shall be of the same manufacturer and shipped to the job site in manufacturer’s original sealed packages/reels indicating name of manufacturer, the date and place of manufacture.

D. Conductors, cables, connectors and splices shall be UL listed and labelled with “UL” listing.

E. Testing Agency Qualifications: Member of NETA. Refer to section “Basic Electrical Requirements” for additional requirements.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
1. Southwire Incorporated.
2. General Cable Technologies Corporation
3. Encore Wire Corporation.
4. Or Equal.

B. Description: Flexible, insulated and uninsulated, soft drawn annealed copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

C. Conductors: Copper, complying with ASTM B3 for bare annealed copper, and with ASTM B8 and ASTM B496 for stranded conductors. Comply with NEMA WC 70/ICEA S-95-658. Minimum size is #12AWG.

D. Conductor Insulation:
1. Type TC-ER. Comply with NEMA WC 70/ICEA S-95-658 and UL 1277.
2. Type THHN and Type THWN-2. Comply with UL 83.

E. Shield:
1. Type TC-ER: Cable designed for use with ASDs, with oversized crosslinked polyethylene insulation, spiral-wrapped foil plus 85 percent coverage braided shields and insulated full-size ground wire, and sunlight- and oil-resistant outer PVC jacket.

2.2 METAL-CLAD CABLE, TYPE MC

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
1. Southwire Incorporated.
2. General Cable Technologies Corporation
3. Encore Wire Corporation.
4. Or Equal.

B. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

C. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors. Comply with UL 1569 for type MC.

D. Ground Conductor: Bare or Insulated.

E. Conductor Insulation: Type TFN/THHN/THWN-2. Comply with UL 83.

F. Armor: Steel, interlocked.

2.3 CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers
1. Ideal Industries, Inc.
2. Ilsco; a branch of Bardes Corporation.
3. O-Z/Gedney; a brand of the EGS Electrical Group.
4. 3M; Electrical Markets Division.
5. Or equal.

B. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

C. Jacketed Cable Connectors: For steel cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
1. Material: Copper.
2. Type: One hole with standard barrels.
3. Termination: Compression.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders:
1. Copper; solid for #10AWG and smaller; stranded for #8 AWG and larger.

B. Branch Circuits:
1. Copper:
a. Solid for #10AWG and smaller; stranded for #8AWG and larger.
b. All branch circuits shall be copper.

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, Partitions, and Crawlspaces: 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. Exposed Branch Circuits, Including in Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway. MC Cable is allowed after a raceway homerun has been provided from the power source to the room where the first circuit resides.

F. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

3.3 INSTALLATION, GENERAL

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points in accordance with Section 260533.13 "Conduits for Electrical Systems" prior to pulling conductors and cables. Conductors shall be installed in clean raceways using approved pulling methods.

C. Conductors shall be pulled into conduit simultaneously to not damage conductors during pulling.

D. Use of gutters or junction boxes to combine several homeruns into a larger conduit shall be permitted. When combining homeruns, the Contractor shall derate all conductors per NEC requirements including reducing the conductor ampacity and use high temperature insulation where necessary. Contractor shall adjust conduit sizes per NEC requirements for any conductor revisions.

E. 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.

F. Use pulling means, including polyester pulling tape (mule tape), polypropylene rope, nylon rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

G. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

H. 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. Splices in wires #10AWG and smaller shall be made with twist-on splicing connector in accordance with UL486-C. Connections in wires #8AWG and larger shall be made with Polaris lugs or equal.

C. Conductors shall be terminated such that no conductor material is exposed. Conductors shall be trained and labeled at terminations in a professional and skillful manner.

D. 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.

E. Mechanical lugs for terminations at equipment shall be rated to accept the conductors specified.
   1. Use reducing pins to facilitate terminations on oversized conductors.

F. All terminations shall be mechanically sound. Pre-twist all terminating conductors prior to the application of an electrical connector. The electrical connector shall not be used for mechanical connection of the conductors.

G. Wiring at Outlets: Install conductor at each outlet, with at least 6 inch (150 mm) of slack.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Where tape or labels are used in lieu of color-coding, apply tape or label material at each end of the conductor, at all splice locations, within all boxes, and at all terminations.

C. 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. 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 of the following visual and electrical tests:
      a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
      b. Test bolted connections for high resistance using one of the following:
         1) A low-resistance ohmmeter.
         2) Calibrated torque wrench.
         3) Thermographic survey.
      c. Inspect compression-applied connectors for correct cable match and indentation.
      d. Inspect for correct identification.
      e. Inspect cable jacket and condition.
      f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500 V(dc) for 300 V rated cable and 1000 V(dc) for 600 V rated cable for a one-minute duration.
      g. Continuity test on each conductor and cable.
      h. Uniform resistance of parallel conductors.

B. Cables will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports 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.

END OF SECTION

SECTION 260526 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Grounding and bonding conductors.
2. Grounding and bonding clamps.
3. Grounding and bonding bushings.
4. Grounding and bonding hubs.
5. Grounding and bonding connectors.
6. Intersystem bonding bridge grounding connector.
7. Grounding and bonding busbars.
8. Grounding (earthing) electrodes.

B. Related Requirements:
1. Section 260010 "Supplemental Requirements for Electrical" specifies additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Field quality-control reports.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:
1. In addition to items specified in Section 260010 "Supplemental Requirements for Electrical," include the following:
a. Instructions for periodic testing and inspection of grounding features at test wells, ring electrodes, and grounding connections for separately derived systems based on NETA MTS.
1) Tests must determine if ground-resistance or impedance values remain within specified maximums, and instructions must recommend corrective action if values do not.
2) Include recommended testing intervals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with the requirements, provide products by one of the following, or equal:
   1. Grounding Connectors, Bars and Rods:
      a. Burndy Corporation
      b. Crouse-Hinds
      c. Erico
      d. Thomas & Betts Corporation
      e. Or Equal
   2. Grounding Conductors and Cables:
      a. Southwire
      b. General Cable
      c. Okonite
      d. Or Equal

2.2 GROUNDING AND BONDING CONDUCTORS

A. Equipment Grounding Conductor:
   1. General Characteristics: 600 V, THHN/THWN-2, copper wire or cable, green color, in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. ASTM - Bare Copper Grounding and Bonding Conductor:
   1. Referenced Standards: Complying with one or more of the following:
      a. Soft or Annealed Copper Wire: ASTM B3.
      b. Concentric-Lay Stranded Copper Conductor: ASTM B8.
      c. Tin-Coated Soft or Annealed Copper Wire: ASTM B33.
      d. 19-Wire Combination Unilay-Stranded Copper Conductor: ASTM B787/B787M.

2.3 GROUNDING AND BONDING CLAMPS

A. Description: Clamps suitable for attachment of grounding and bonding conductors to grounding electrodes, pipes, tubing, and rebar. Grounding and bonding clamps specified in this article are also suitable for use with communications applications.

B. Performance Criteria:
   1. Regulatory Requirements:
      a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
   2. Listing Criteria:
      a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
      b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.

C. UL KDER and KDSH - U-Bolt-Type Pipe and Rod Grounding and Bonding Clamp:

1. General Characteristics:
   a. Clamp Material: Brass.
   b. Listed for outdoor use.

D. UL KDER - Beam Grounding and Bonding Clamp:
1. General Characteristics: Mechanical-type, terminal, ground wire access from four directions; with dual, tin-plated or silicon bronze bolts.

E. UL KDER - Exothermically Welded Connection:
1. General Characteristics: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.4 GROUNDING AND BONDING BUSHINGS

A. Description: Bonding bushings connect conduit fittings, tubing fittings, threaded metal conduit, and unthreaded metal conduit to metal boxes and equipment enclosures, and have one or more bonding screws intended to provide electrical continuity between bushing and enclosure. Grounding bushings have provision for connection of bonding or grounding conductor and may or may not also have bonding screws.

B. Performance Criteria:
1. Regulatory Requirements:
   a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria:
   a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

C. UL KDER - Bonding Bushing:
1. General Characteristics: Threaded bushing with insulated throat.

D. UL KDER - Grounding Bushing:
1. General Characteristics: Threaded bushing with insulated throat and mechanical-type wire terminal.

2.5 GROUNDING AND BONDING HUBS

A. Description: Hubs with certified grounding or bonding locknut.

B. Performance Criteria:
1. Regulatory Requirements:
   a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria:
   a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

C. UL KDER - Grounding and Bonding Hub:

1. General Characteristics: Insulated, gasketed, watertight hub with mechanical-type wire terminal.

2.6 GROUNDING AND BONDING CONNECTORS

A. Performance Criteria:
   1. Regulatory Requirements:
      a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
   2. Listing Criteria:
      a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
      b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.

B. UL KDER - Pressure-Type Grounding and Bonding Busbar Cable Connector:

   1. General Characteristics: Copper or copper alloy, for compression bonding of one or more conductor directly to copper busbar. Listed for direct burial.

C. UL KDER - Lay-In Lug Mechanical-Type Grounding and Bonding Busbar Terminal:
   1. General Characteristics: Mechanical-type, copper rated for direct burial terminal with set screw.

D. UL KDER - Crimped Pressure-Type Grounding and Bonding Cable Connector:
   1. General Characteristics: Crimp-and-compress connectors that bond to conductor when connector is compressed around conductor.
      a. Copper alloy, C and H shaped.

2.7 GROUNDING AND BONDING BUSBARS

A. Description: Miscellaneous grounding and bonding devices that serve as common connection for multiple grounding and bonding conductors.

B. Performance Criteria:
   1. Regulatory Requirements:
      a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
   2. Listing Criteria:
      a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

C. UL KDER - Equipment Room Grounding and Bonding Busbar:
   1. General Characteristics:
      a. Bus: Rectangular bar of annealed copper.
      b. Mounting Stand-Off Insulators: Lexan or PVC.
         1) Comply with UL 891 for use in 600 V switchboards, impulse tested at 5000 V.
   2. Options:

a. Dimensions: 1/4 by 4 inch (6.3 by 100 mm) in cross section; length as indicated on Drawings.
b. Predrilled Hole Pattern: Suitable for installing specified grounding and bonding connectors.
c. Mounting Hardware: Stand-off brackets that provide 4 inch (100 mm) clearance to access rear of bus. Brackets and bolts must be stainless steel.

2.8 GROUNDING (EARTHING) ELECTRODES

A. Performance Criteria:
1. Regulatory Requirements:
a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria:
a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

B. UL KDER - Rod Electrode:
1. General Characteristics: Copper-clad steel; 3/4 inch by 10 ft (19 mm by 3 m).

2.9 GROUNDING ELECTRODE ENCLOSURES

A. Description: Enclosures designed to protect grounding electrodes from damage while providing access for inspection and testing of the grounding system.

B. Grounding Electrode Access Well Enclosure:
1. Product Characteristics:
a. Well Material: Concrete.
b. Cover Material: Concrete.
c. Cover Strength: Sidewalk or turf use.
2. Required Product Options:
a. Round:
1) Nominal Diameter: 8 inch (200 mm).
2) Nominal Height: 10 inch (250 mm).
3) Slotted sides for installation after grounding connections made.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine facility's grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of electrical system.

B. Inspect test results of grounding system measured at point of electrical service equipment connection.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with connection of electrical service equipment only after unsatisfactory conditions have been corrected.

3.2 SELECTION OF GROUNDING AND BONDING PRODUCTS

A. Grounding and Bonding Conductors:
   1. Provide solid conductor for 8 AWG and smaller, and stranded conductors for 6 AWG and larger unless otherwise indicated.
   2. Custom-Length Insulated Equipment Bonding Jumpers: 6 AWG, 19-strand, Type THHN.
   3. Bonding Cable: 28 kcmil, 14 strands of 17 AWG conductor, 1/4 inch (6 mm) in diameter.
   4. Bonding Conductor: 4 AWG or 6 AWG, stranded conductor.
   5. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch (41 mm) wide and 1/16 inch (1.6 mm) thick.
   6. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch (41 mm) wide and 1/16 inch (1.6 mm) thick.
   7. Underground Grounding Conductors: Install bare tinned-copper conductor, 2/0 AWG minimum.

B. Grounding and Bonding Connectors:
   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.

C. Grounding and Bonding Busbars: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated on Drawings.

3.3 INSTALLATION OF GROUNDING AND BONDING

A. Comply with manufacturer's published instructions.

B. Special Techniques:
   1. Grounding and Bonding Conductors:
      a. 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. Underground Grounding Conductors:
         1) Bury at least 30 inch (750 mm) below grade.
         2) Duct-Bank Grounding Conductor: Bury 12 inch (300 mm) above duct bank when indicated as part of duct-bank installation.
   2. Grounding and Bonding Connectors: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.

a. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
b. Make connections with clean, bare metal at points of contact.
c. Make aluminum-to-steel connections with stainless steel separators and mechanical clamps.
d. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
e. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
f. 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 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 disconnect-type connection is required, use bolted clamp.
g. Grounding and Bonding for Piping:
    1) Metal Water Service Pipe: 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 bolted clamp connector or bolt lug-type connector to pipe flange by using one of lug bolts of flange. Where 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) Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with bolted connector.
    3) Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

3. Grounding and Bonding Busbars:
    a. Install busbar horizontally, on insulated spacers 2 inch (50 mm) minimum from wall, 6 inch (150 mm) above finished floor unless otherwise indicated.
    b. Where busbars are indicated on both sides of doorways, route bonding conductor up to top of door frame, across top of doorway, and down; connect to continuation of horizontal busbar.
4. Electrodes:
    a. Ground Rods: Drive rods until tops are 2 inch (50 mm) 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) Use exothermic welds for below-grade connections.
    b. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least same distance from other grounding electrodes, and connect to service grounding electrode conductor.
    c. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and

Raceways for Electrical Systems," and must be at least 12 inch (300 mm) deep, with cover.

1) Install at least one test well for each service unless otherwise indicated. Install at ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

d. Concrete-Encased Electrode (Ufer Ground):

1) Fabricate in accordance with NFPA 70; use minimum of 20 ft (6 m) of bare copper conductor not smaller than 4 AWG.

a) If concrete foundation is less than 20 ft (6 m) long, coil excess conductor within base of foundation.

b) Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts.

2) Fabricate in accordance with NFPA 70; using electrically conductive coated steel reinforcing bars or rods, at least 20 ft (6.0 m) long. If reinforcing is in multiple pieces, connect together by usual steel tie wires or exothermic welding to create required length.

5. Grounding at Service:

a. Equipment grounding conductors and grounding electrode conductors must be connected to ground busbar. Install main bonding jumper between neutral and ground buses.

6. Equipment Grounding and Bonding:

a. Install insulated equipment grounding conductors with 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 switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
9) X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.

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. Poles Supporting Outdoor Lighting Fixtures: Bond insulated equipment grounding conductor to equipment grounding terminal inside pole base.

3.4 FIELD QUALITY CONTROL FOR GROUNDING AND BONDING

A. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with calibrated torque wrench in accordance with manufacturer's published instructions.
3. Test completed grounding system at each location where maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before conductors are connected.
    a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method in accordance with IEEE Std 81.
    c. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

B. Nonconforming Work:
1. Grounding system will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective components and retest.

C. Collect, assemble, and submit test and inspection reports.
1. Report measured ground resistances that exceed the following values:
    a. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 25 Ω.
    b. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 25 Ω.
    c. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 25 Ω.
    d. Power Distribution Units or Panelboards Serving Electronic Equipment: 25 Ω.
    e. Substations and Pad-Mounted Equipment: 25 Ω.
    f. Manhole Grounds: 10 Ω.

3.5 PROTECTION

A. After installation, protect grounding and bonding cables and equipment from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION

SECTION 260529 – HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Support, anchorage, and attachment components.
   2. Fabricated metal equipment support assemblies.

B. Related Requirements:
   1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data:
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
      a. Slotted support systems, hardware, and accessories.
      b. Clamps.
      c. Hangers.
      d. Sockets.
      e. Eye nuts.
      f. Fasteners.
      g. Anchors.
      h. Saddles.
      i. Brackets.
   2. Include rated capacities and furnished specialties and accessories.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. For fabrication and installation details for electrical hangers and support systems.
   1. Hangers. Include product data for components.
   2. Slotted support systems.
   3. Equipment supports.

1.3 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For hangers and supports for electrical equipment and systems, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Welding certificates.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Flame Rating: Class 1.
   2. Self-extinguishing according to ASTM D635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32 inch (10 mm) diameter holes at a maximum of 8 inch (200 mm) on center in at least one surface.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Allied Tube & Conduit.
      b. B-Line, Inc.; an Eaton Business.
      c. ERICO International Corporation.
      d. GS Metals Corp.
      e. Thomas & Betts Corporation.
      f. Unistrut; Tyco International, Ltd.
   2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
   3. Material for Channel, Fittings, and Accessories: Galvanized steel.
   4. Channel Width: 1-5/8 inch (41.25 mm).
   5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
   6. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
   7. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
   8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

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 must have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body must be made of malleable iron.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M 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.
      a. Subject to compliance with the requirements, provide products by one of the following:
         1) Hilti Inc.
         2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
         3) MKT Fastening, LLC.
         4) Simpson Strong Tie Co.
         5) Or Equal.
   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.
      a. Subject to compliance with the requirements, provide products by one of the following:
         1) Hilti Inc.
         2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
         3) Or Equal.
   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 F3125/F3125M, Grade A325 (Grade A325M).
   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 SELECTION

A. Comply with the following standards for selection and installation of hangers and supports, except where requirements on Drawings or in this Section are stricter:
   1. NECA NEIS 101
   2. NECA NEIS 102.
   3. NECA NEIS 105.
   4. NECA NEIS 111.

B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for raceways specified in Section 260533.13 "Conduits for Electrical Systems."

D. Comply with requirements for boxes specified in Section 260533.16 "Boxes and Covers for Electrical Systems."

E. Provide vibration and seismic controls with hangers and supports in accordance with requirements specified in "Section 260548 "Vibration and Seismic Controls for Electrical Systems."

F. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and ERMC as required by NFPA 70. Minimum rod size must be 1/4 inch (6 mm) in diameter.

G. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted 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.

H. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2 inch (38 mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.2 INSTALLATION OF SUPPORTS

A. Comply with NECA NEIS 101 for installation requirements except as specified in this article.

B. Raceway Support Methods: In addition to methods described in NECA NEIS 1, EMT and ERMC may be supported by openings through structure members, in accordance with NFPA 70.

C. 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 must be weight of supported components plus 200 lb (90 kg).

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
   1. To Wood: Fasten with lag screws or through bolts.
   2. To New Concrete: Bolt to concrete inserts.
   3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
   4. To Existing Concrete: Expansion anchor fasteners.

5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inch (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inch (100 mm) thick.
6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts, or Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

E. 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. Submit welding certificates.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 4 inch (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000 psi (20.7 MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."

C. Anchor equipment to concrete base as follows:
1. Place and secure anchorage devices. Use supported equipment manufacturer's 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.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup:
1. 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.

2. Comply with requirements in these specifications for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION

SECTION 260533.13 – CONDUITS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Type EMT-S duct raceways and elbows.
2. Type ERMC-S duct raceways, elbows, couplings, and nipples.
3. Type FMC-S duct raceways.
4. Type LFMC duct raceways.
5. Type PVC duct raceways and fittings.
6. Fittings for conduit, tubing, and cable.
7. Electrically conductive corrosion-resistant compounds for threaded conduit.
8. Solvent cements.

B. Products Installed, but Not Furnished, under This Section:
1. See Section 260553 "Identification for Electrical Systems" for electrical equipment labels.

C. Related Requirements:
1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260519 "Low-Voltage for Electrical Power Conductors and Cables" for nonmetallic underground conduit with conductors (Type NUCC).
3. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior duct banks, manholes, and underground utility construction.

1.2 ACTION SUBMITTALS

A. Product Data:
1. Type EMT-S duct raceways and elbows.
2. Type ERMC-S duct raceways, elbows, couplings, and nipples.
3. Type FMC-S duct raceways.
4. Type LFMC duct raceways.
5. Type PVC duct raceways and fittings.
6. Fittings for conduit, tubing, and cable.
7. Electrically conductive corrosion-resistant compounds for threaded conduit.
8. Solvent cements.

B. Sustainable design submittals.
1. Solvent cements.

1.3 INFORMATIONAL SUBMITTALS

A. Manufacturers' Published Instructions:

1. Type EMT-S duct raceways and elbows.
2. Type ERMC-S duct raceways, elbows, couplings, and nipples.
3. Type FMC-S duct raceways.
4. Type LFMC duct raceways.
5. Type PVC duct raceways and fittings.
6. Fittings for conduit, tubing, and cable.
7. Electrically conductive corrosion-resistant compounds for threaded conduit.
8. Solvent cements.

PART 2 - PRODUCTS

2.1 TYPE EMT-S DUCT RACEWAYS AND ELBOWS

A. Performance Criteria:
1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN FJMX; including UL 797.

B. Source Quality Control:
1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL FJMX - Steel Electrical Metal Tubing (EMT-S) and Elbows:
1. Material: Steel.
2. Options:
   a. Exterior Coating: Zinc.
   b. Interior Coating: Zinc with organic top coating.
   c. Minimum Trade Size: Metric designator 21 (trade size 3/4).
   d. Colors: As indicated on Drawings.

2.2 TYPE ERMC-S DUCT RACEWAYS, ELBOWS, COUPLINGS, AND NIPPLES

A. Performance Criteria:
1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN DYIX; including UL 6.

B. Source Quality Control:
1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL DYIX - Galvanized-Steel Electrical Rigid Metal Conduit (ERMC-S-G), Elbows, Couplings, and Nipples:

1. Exterior Coating: Zinc.
2. Options:
    a. Interior Coating: Zinc with organic top coating.
    b. Minimum Trade Size: Metric designator 21 (trade size 3/4).
    c. Colors: As indicated on Drawings.

D. UL DYIX - PVC-Coated-Steel Electrical Rigid Metal Conduit (ERMC-S-PVC), Elbows, Couplings, and Nipples:
1. Options:
    a. Exterior Coating: PVC complying with NEMA RN 1.
    b. Interior Coating: Zinc with organic top coating.
    c. Minimum Trade Size: Metric designator 21 (trade size 3/4).
    d. Colors: As indicated on Drawings.
    e. Conduit Fittings for Hazardous (Classified) Locations: UL 1203.
    f. Expansion and Deflection Fittings: UL 651 with flexible bonding jumper.

2.3 TYPE FMC-S DUCT RACEWAYS

A. Performance Criteria:
1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN DXUZ; including UL 1.

B. Source Quality Control:
1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL DXUZ - Steel Flexible Metal Conduit (FMC-S):
1. Material: Steel.
2. Options:
    a. Minimum Trade Size: Metric designator 21 (trade size 3/4).
    b. Colors: As indicated on Drawings.

2.4 TYPE LFMC DUCT RACEWAYS

A. Performance Criteria:
1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN DXHR; including UL 360.

B. Source Quality Control:
1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL DXHR - Steel Liquidtight Flexible Metal Conduit (LFMC-S):
1. Material: Steel.
2. Options:
a. Minimum Trade Size: Metric designator 21 (trade size 3/4).
b. Colors: As indicated on Drawings.

2.5 TYPE PVC DUCT RACEWAYS AND FITTINGS

A. Performance Criteria:
1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN DZYR; including UL 651.

B. Source Quality Control:
1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL DZYR - Schedule 40 Rigid PVC Conduit (PVC-40) and Fittings:
1. Dimensional Specifications: Schedule 40.
2. Options:
a. Minimum Trade Size: Metric designator 21 (trade size 3/4).
b. Markings: For use with maximum 90 deg C wire.

2.6 FITTINGS FOR CONDUIT, TUBING, AND CABLE

A. Performance Criteria:
1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

B. Source Quality Control:
1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL DWTT - Fittings for Type ERMC and Type PVC, Duct Raceways:
1. Listing Criteria: UL CCN DWTT; including UL 514B.
2. Options:
a. Material: Die cast.
b. Coupling Method: Compression coupling or Setscrew coupling. Setscrew couplings with only single screw per conduit are unacceptable.
c. Expansion and Deflection Fittings: UL 651 with flexible bonding jumper.

D. UL FKAV - Fittings for Type EMT Duct Raceways:
1. Listing Criteria: UL CCN FKAV; including UL 514B.
2. Options:

a. Material: Die cast.
b. Coupling Method: Compression coupling or Setscrew coupling. Setscrew couplings with only single screw per conduit are unacceptable.
c. Expansion and Deflection Fittings: UL 651 with flexible bonding jumper.

E. UL DXAS - Fittings for Type LFMC Duct Raceways:
1. Listing Criteria: UL CCN DXAS; including UL 514B.

2.7 ELECTRICALLY CONDUCTIVE CORROSION-RESISTANT COMPOUNDS FOR THREADED CONDUIT

A. Performance Criteria:
1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN FOIZ; including UL Subject 2419.

B. Source Quality Control:
1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

2.8 SOLVENT CEMENTS

A. Performance Criteria:
1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN DWTT; including UL 514B.

B. Source Quality Control:
1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

PART 3 - EXECUTION

3.1 SELECTION OF CONDUITS FOR ELECTRICAL SYSTEMS

A. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NFPA 70 for selection of duct raceways. Consult Architect for resolution of conflicting requirements.

B. Outdoors:
1. Exposed and Subject to Severe Physical Damage: ERMC.
2. Exposed and Subject to Physical Damage: ERMC.

a. Locations less than 2.5 m (8 ft) above finished floor.
3. Exposed and Not Subject to Physical Damage: Corrosion-resistant EMT.
4. Concealed Aboveground: EMT.
5. Concrete Encased in Trench: PVC-40.
6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

C. Indoors:
1. Hazardous Classified Locations: ERMC.
2. Exposed and Subject to Severe Physical Damage: ERMC. Locations include the following:
a. Loading docks.
b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
c. Mechanical rooms.
d. Gymnasiums.
3. Exposed and Subject to Physical Damage: ERMC. Locations include the following:
a. Locations less than 2.5 m (8 ft) above finished floor.
4. Exposed and Not Subject to Physical Damage: EMT.
5. Concealed in Ceilings and Interior Walls and Partitions: EMT.
6. Damp or Wet Locations: Corrosion-resistant EMT.
7. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

D. Duct Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines.
1. ERMC: Provide threaded-type fittings unless otherwise indicated.

3.2 INSTALLATION OF CONDUITS FOR ELECTRICAL SYSTEMS

A. Comply with manufacturer's published instructions.

B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:
1. Type EMT-S: Article 358 of NFPA 70 and NECA NEIS 101.
2. Type ERMC-S: Article 344 of NFPA 70 and NECA NEIS 101.
3. Type FMC-S: Article 348 of NFPA 70 and NECA NEIS 101.
4. Type LFMC: Article 350 of NFPA 70 and NECA NEIS 101.
5. Type PVC: Article 356 of NFPA 70 and NECA NEIS 111.
6. Expansion Fittings: NEMA FB 2.40.
7. Consult Architect for resolution of conflicting requirements.

C. Special Installation Techniques:
1. General Requirements for Installation of Duct Raceways:
a. Complete duct raceway installation before starting conductor installation.
b. Provide stub-ups through floors with coupling threaded inside for plugs, set flush with finished floor. Plug coupling until conduit is extended above floor to final destination or a minimum of 2 ft (0.6 m) above finished floor.
c. Install no more than equivalent of four 90-degree bends in conduit run. Support within 12 inch (300 mm) of changes in direction.

d. Make bends in duct raceway using large-radius preformed ells except for parallel bends. Field bending must be in accordance with NFPA 70 minimum radii requirements. Provide only equipment specifically designed for material and size involved.
e. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
f. Support conduit within 12 inch (300 mm) of enclosures to which attached.
g. Install duct sealing fittings at accessible locations in accordance with NFPA 70 and fill them with listed sealing compound. For concealed duct raceways, install fitting in flush steel box with blank cover plate having finish similar to that of adjacent plates or surfaces. Install duct sealing fittings in accordance with NFPA 70.
h. Install devices to seal duct raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal interior of duct 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 duct raceway enters a building or structure.
    3) Conduit extending from interior to exterior of building.
    4) Conduit extending into pressurized duct raceway and equipment.
    5) Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
    6) Where otherwise required by NFPA 70.
i. Do not install duct raceways or electrical items on "explosion-relief" walls or rotating equipment.
j. Do not install conduits within 2 inch (50 mm) of the bottom side of a metal deck roof.
k. Keep duct raceways at least 6 inch (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal duct raceway runs above water and steam piping.
l. Cut conduit perpendicular to the length. For conduits metric designator 53 (trade size 2) and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Ream inside of conduit to remove burrs.
m. Install pull wires in empty duct raceways. Provide polypropylene or monofilament plastic line with not less than 200 lb (90 kg) tensile strength. Leave at least 12 inch (300 mm) of slack at both ends of pull wire. Cap underground duct raceways designated as spare above grade alongside duct raceways in use.
n. Install duct raceways square to the enclosure and terminate at enclosures without hubs with locknuts on both sides of enclosure wall. Install locknuts hand tight, plus one-quarter turn more.
    1) Termination fittings with shoulders do not require two locknuts.
o. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to metric designator 35 (trade size 1-1/4) and insulated throat metal bushings on metric designator 41 (trade size 1-1/2) and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

2. Types ERMC:

a. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound that maintains electrical conductivity to threads of duct raceway and fittings before making up joints. Follow compound manufacturer's published instructions.

3. Type ERMC-S-PVC:
   a. Follow manufacturer's installation instructions for clamping, cutting, threading, bending, and assembly.
   b. Provide PVC-coated sealing locknut for exposed male threads transitioning into female NPT threads that do not have sealing sleeves, including transitions from PVC couplings/female adapters to Type ERMC-S-PVC elbows in direct-burial applications. PVC-coated sealing locknuts must not be used in place of conduit hub. PVC-coated sealing locknut must cover exposed threads on Type ERMC-S-PVC duct raceway.
   c. Coat field-cut threads on PVC-coated duct raceway with manufacturer-approved corrosion-preventing conductive compound prior to assembly.
4. Types FMC and LFMC:
   a. Provide a maximum of 72 inch (1830 mm) of flexible conduit for recessed and semi recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
5. Types PVC:
   a. Do not install Type PVC, Type HDPE, or Type EPEC conduit where ambient temperature exceeds 122 deg F (50 deg C). Conductor ratings must be limited to 75 deg C except where installed in a trench outside buildings with concrete encasement, where 90 deg C conductors are permitted.
   b. Comply with manufacturer's published instructions for solvent welding and fittings.
6. Duct Raceways Embedded in Slabs:
   a. .Arrange duct raceways to cross building expansion joints with expansion fittings at right angles to the joint.
   b. Arrange duct raceways to ensure that each is surrounded by minimum of 2 inch (50 mm) of concrete without voids.
   c. Do not embed threadless fittings in concrete unless locations have been specifically approved by Architect.
   d. Change from ENT to PVC-40 before rising above floor.
7. Stub-ups to Above Recessed Ceilings:
   a. Provide EMT or ERMC for duct raceways.
   b. Provide a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
8. Duct Raceway Terminations at Locations Subject to Moisture or Vibration:
   a. Provide insulating bushings to protect conductors, including conductors smaller than 4 AWG. Install insulated throat metal grounding bushings on service conduits.
9. Duct Fittings: Install fittings in accordance with NEMA FB 2.10 guidelines.
   a. ERMC-S-PVC: Provide only fittings listed for use with this type of conduit. Patch and seal joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Provide sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
   b. EMT: Provide setscrew or compression, steel fittings. Comply with NEMA FB 2.10.

c. Flexible Conduit: Provide only fittings listed for use with flexible conduit type. Comply with NEMA FB 2.20.

10. Expansion-Joint Fittings:
    a. Install in runs of aboveground PVC that are located where environmental temperature change may exceed 30 deg F (17 deg C) and that have straight-run length that exceeds 25 ft (7.6 m). Install in runs of aboveground ERMC and EMT conduit that are located where environmental temperature change may exceed 100 deg F (55 deg C) and that have straight-run length that exceeds 100 ft (30 m).
    b. Install type and quantity of fittings that accommodate temperature change listed for the following locations:
        1) Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
        2) Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
        3) Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
        4) Attics: 135 deg F (75 deg C) temperature change.
    c. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.
    d. Install expansion fittings at locations where conduits cross building or structure expansion joints.
    e. Install expansion-joint fitting with position, mounting, and piston setting selected in accordance with manufacturer's published instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
11. Duct Raceways Penetrating Rooms or Walls with Acoustical Requirements: Seal duct raceway openings on both sides of rooms or walls with acoustically rated putty.
12. Identification: Provide labels for conduit assemblies, duct raceways, and associated electrical equipment.
    a. Provide warning signs.

D. Interfaces with Other Work:
1. Coordinate installation of new products with existing conditions.
2. Coordinate with Section 078413 "Penetration Firestopping" for installation of firestopping at penetrations of fire-rated floor and wall assemblies.
3. Coordinate with Section 260529 "Hangers and Supports for Electrical Systems" for installation of conduit hangers and supports.

3.3 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

SECTION 260533.16 – BOXES AND COVERS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Metallic outlet boxes, device boxes, rings, and covers.
2. Nonmetallic outlet boxes, device boxes, rings, and covers.
3. Junction boxes and pull boxes.
4. Cover plates for device boxes.
5. Hoods for outlet boxes.

B. Products Installed, but Not Furnished, under This Section:
1. See Section 260553 "Identification for Electrical Systems" for electrical equipment labels.

C. Related Requirements:
1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data:
1. Metallic outlet boxes, device boxes, rings, and covers.
2. Nonmetallic outlet boxes, device boxes, rings, and covers.
3. Junction boxes and pull boxes.
4. Cover plates for device boxes.
5. Hoods for outlet boxes.

B. Shop Drawings:
1. Shop drawings for floor boxes.

PART 2 - PRODUCTS

2.1 METALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

A. Performance Criteria:
1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN QCIT; including UL 514A.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL QCIT - Metallic Outlet Boxes and Covers:
1. Description: Box having pryout openings, knockouts, threaded entries, or hubs in either the sides of the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.
2. Options:
a. Material: Sheet steel.
b. Sheet Metal Depth: Minimum 2.5 inch (65 mm).
c. Cast-Metal Depth: Minimum 2.4 inch (60.3 mm).
d. Luminaire Outlet Boxes and Covers: Nonadjustable, listed and labeled for attachment of luminaire weighing up to 50 lb (23 kg).
e. Paddle Fan Outlet Boxes and Covers: Nonadjustable, designed for attachment of paddle fan weighing up to 70 lb (32 kg).

D. UL QCIT - Metallic Conduit Bodies:
1. Description: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.

E. UL QCIT - Metallic Device Boxes:
1. Description: Box with provisions for mounting wiring device directly to box.
2. Options:
a. Material: Sheet steel.
b. Sheet Metal Depth: minimum 2.5 inch (65 mm).
c. Cast-Metal Depth: minimum 2.4 inch (60.3 mm).

F. UL QCIT - Metallic Extension Rings:
1. Description: Ring intended to extend sides of outlet box or device box to increase box depth, volume, or both.

G. UL QCIT - Metallic Floor Boxes and Floor Box Covers:
1. Description: Box mounted in floor with floor box cover and other components to complete floor box enclosure.

H. UL QCIT - Metallic Concrete Boxes and Covers:
1. Description: Box intended for use in poured concrete.

2.2 NONMETALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

A. Performance Criteria:
1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. Listing Criteria: UL CCN QCMZ; including UL 514C.

B. Source Quality Control:

1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL QCMZ - Nonmetallic Outlet Boxes and Covers:
1. Description: Box having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.

D. UL QCMZ - Nonmetallic Conduit Bodies:
1. Description: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.

E. UL QCMZ - Nonmetallic Device Boxes:
1. Description: Box with provisions for mounting wiring device directly to box.

F. UL QCMZ - Nonmetallic Extension Rings:
1. Description: Ring intended to extend sides of outlet box or device box to increase box depth, volume, or both.

G. UL QCMZ - Nonmetallic Floor Boxes and Floor Box Covers:
1. Description: Box mounted in floor with floor box cover and other components to complete floor box enclosure.

H. UL QCMZ - Nonmetallic Concrete Boxes and Covers:
1. Description: Box intended for use in poured concrete.

2.3 JUNCTION BOXES AND PULL BOXES

A. Performance Criteria:
1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. Listing Criteria: UL CCN BGUZ; including UL 50 and UL 50E.

B. Source Quality Control:
1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL BGUZ - Indoor Sheet Metal Junction and Pull Boxes:
1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Options:
a. Degree of Protection: Type 1 or as indicated on drawings.

D. UL BGUZ - Indoor Cast-Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Options:
   a. Degree of Protection: Type 1 or as indicated on drawings.

E. UL BGUZ - Indoor Polymeric Junction and Pull Boxes:
1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Options:
   a. Degree of Protection: Type 1.

F. UL BGUZ - Outdoor Sheet Metal Junction and Pull Boxes:
1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Options:
   a. Degree of Protection: Type 3R.

G. UL BGUZ - Outdoor Cast-Metal Junction and Pull Boxes:
1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Options:
   a. Degree of Protection: Type 3R.

H. UL BGUZ - Outdoor Polymeric Junction and Pull Boxes:
1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.
2. Options:
   a. Degree of Protection: Type 3R .

2.4 COVER PLATES FOR DEVICES BOXES

A. Performance Criteria:
1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. Listing Criteria: UL CCN QCIT or UL CCN QCMZ; including UL 514D.
3. Wallplate-Securing Screws: Metal with head color to match wallplate finish.

B. Source Quality Control:
1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL QCIT or QCMZ - Metallic Cover Plates for Device Boxes:
1. Options:
   a. Damp and Wet Locations: Listed, labeled, and marked for location and use. Provide gaskets and accessories necessary for compliance with listing.
   b. Wallplate Material: 0.032 inch (0.8 mm) thick, Type 302/304 non-magnetic stainless steel with brushed finish.

D. UL QCIT or QCMZ - Nonmetallic Cover Plates for Device Boxes:

1. Options:
    a. Damp and Wet Locations: Listed, labeled, and marked for location and use. Provide gaskets and accessories necessary for compliance with listing.
    b. Wallplate Material: 0.060 inch (1.5 mm) thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device.
    c. Color: As indicated on architectural Drawings.

2.5 HOODS FOR OUTLET BOXES

A. Performance Criteria:
1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. Listing Criteria:
    a. UL CCN QCIT or UL CCN QCMZ; including UL 514D.
    b. Receptacle, Hood, Cover Plate, Gaskets, and Seals: UL 498 Supplement SA when mated with box or enclosure complying with UL 514A, UL 514C, or UL 50E.
3. Mounts to box using fasteners different from wiring device.

B. Source Quality Control:
1. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
2. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. UL QCIT or QCMZ - Extra-Duty, While-in-Use Hoods for Outlet Boxes:
1. Additional Characteristics: Marked "Extra-Duty" in accordance with UL 514D.
2. Options:
    a. Provides clear, weatherproof, "while-in-use" cover.
    b. Manufacturer may combine nonmetallic device box with hood as extra-duty rated assembly.

PART 3 - EXECUTION

3.1 PREPARATION

A. Shop Drawings: Prepare and submit the following:
1. Shop Drawings for Floor Boxes: Show that floor boxes are located to avoid interferences and are structurally allowable. Indicate floor thickness where boxes are embedded in concrete floors and underfloor clearances where boxes are installed in raised floors.

3.2 SELECTION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

A. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NFPA 70 for selection of boxes and enclosures. Consult Architect for resolution of conflicting requirements.

B. Degree of Protection:
   1. Outdoors:
      a. Type 3R unless otherwise indicated.
      b. Locations Exposed to Hosedown: Type 4.
      c. Locations Subject to Potential Flooding: Type 6P.
      d. Locations in-Ground or Exposed to Corrosive Agents: Type 4X.
      e. Locations in-Ground or Exposed to Corrosive Agents Where Mechanism Must Operate When Ice Covered: Type 3SX.
   2. Indoors:
      a. Type 1 unless otherwise indicated.
      b. Damp or Dusty Locations: Type 12.
      c. Surface Mounted in Kitchens and Other Locations Exposed to Oil or Coolants: Type 12.
      d. Flush Mounted in Kitchens and Other Locations Exposed to Oil or Coolants: Type 12.
      e. Locations Exposed to Airborne Dust, Lint, Fibers, or Flyings: Type 4.
      f. Locations Exposed to Hosedown: Type 4.
      g. Locations Exposed to Brief Submersion: Type 6.
      h. Locations Exposed to Prolonged Submersion: Type 6P.
      i. Locations Exposed to Corrosive Agents: Type 4X.
      j. Locations Exposed to Spraying Oil or Coolants: Type 13.

C. Exposed Boxes Installed Less Than 2.5 m (8 ft) Above Floor:
   1. Provide cast-metal boxes.
   2. Provide exposed cover. Flat covers with angled mounting slots or knockouts are prohibited.

3.3 INSTALLATION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

A. Comply with manufacturer's published instructions.

B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:
   1. Outlet, Device, Pull, and Junction Boxes: Article 314 of NFPA 70.
   2. Consult Architect for resolution of conflicting requirements.

C. Special Installation Techniques:
   1. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.
   2. 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.
   3. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
   4. Locate boxes so that cover or plate will not span different building finishes.
   5. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.
   6. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for purpose.

7. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.
8. Set metal floor boxes level and flush with finished floor surface.
9. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
10. Do not install aluminum boxes, enclosures, or fittings in contact with concrete or earth.
11. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.
12. Boxes and Enclosures in Areas or Walls with Acoustical Requirements:
    a. Seal openings and knockouts in back and sides of boxes and enclosures with acoustically rated putty.
    b. Provide gaskets for wallplates and covers.
13. Identification: Provide labels for boxes and associated electrical equipment.
    a. Identify field-installed conductors, interconnecting wiring, and components.
    b. Provide warning signs.
    c. Label each box with engraved metal or laminated-plastic nameplate.

D. Interfaces with Other Work:
1. Coordinate with Section 260573.13 "Short-Circuit Studies" for determining available fault current on input feeder.
2. Coordinate with Section 260573.19 "Arc-Flash Hazard Analysis" for determining arc-flash hazard on input feeder.

3.4 CLEANING

A. Remove construction dust and debris from boxes before installing wallplates, covers, and hoods.

3.5 PROTECTION

A. After installation, protect boxes from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION

SECTION 260543 – UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Type PVC raceways and fittings.
2. Fittings for conduit, tubing, and cable.
3. Electrically conductive corrosion-resistant compounds for threaded conduit.
4. Solvent cements.
5. Duct accessories.
6. Handholes and boxes for exterior underground wiring.
7. Duct sealing.

B. Related Requirements:
1. Section 260010 "Supplemental Requirements for Electrical" specifies additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260519 "Low-Voltage for Electrical Power Conductors and Cables" specifies nonmetallic underground conduit with conductors (Type NUCC).
3. Section 260553 "Identification for Electrical Systems" specifies underground-line warning tape.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. For concrete and steel used in precast concrete manholes and handholes, also include product certificates as required by ASTM C858.

B. Shop Drawings:
1. Electric Duct Banks and Structures:
a. Include plans, elevations, sections, and details, including attachments to other Work.
b. Indicate locations of all easements.
2. Precast or Factory-Fabricated Concrete Structures:
a. Include plans, elevations, sections, and details, including attachments to other Work.
b. Include duct entry provisions, including locations and duct sizes, and methods and materials for waterproofing duct entry locations.
c. Include reinforcement details.
d. Include frame and cover design and manhole chimneys.
e. Include ladder details.
f. Include grounding details.
g. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, sumps, and other accessories.
h. Include joint details.
3. Factory-Fabricated Handholes and Boxes Other Than Precast Concrete:

a. Include dimensioned plans, sections, and elevations, and fabrication and installation details.
b. Include duct entry provisions, including locations and duct sizes, and methods and materials for waterproofing duct entry locations.
c. Include cover design.
d. Include grounding details.
e. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, and other accessories.

C. Field quality-control reports.

1.3 INFORMATIONAL SUBMITTALS

A. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

B. Field Reports:
1. Factory Test Reports: For handholes and boxes.
2. Manufacturer's field reports for field quality-control support.

PART 2 - PRODUCTS

2.1 TYPE PVC RACEWAYS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cantex, Inc.
2. Allied Tube and Conduit
3. Carlon Electrical Products.
4. JM Eagle
5. Or equal.

B. Performance Criteria:
1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 651 and UL CCN DZYR.

C. Schedule 40 Rigid PVC Conduit (PVC-40) and Fittings:
1. Dimensional Specifications: Schedule 40.
2. Options:
a. Minimum Trade Size: Metric designator 21 (trade size 3/4).
b. Markings: For use with maximum 90 deg C wire.

2.2 FITTINGS FOR CONDUIT, TUBING, AND CABLE

A. Performance Criteria:
1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.

2.3 ELECTRICALLY CONDUCTIVE CORROSION-RESISTANT COMPOUNDS FOR THREADED CONDUIT

A. Performance Criteria:
1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL Subject 2419 and UL CCN FOIZ.

2.4 SOLVENT CEMENTS

A. Performance Criteria:
1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: As recommended by conduit manufacturer in accordance with UL 514B and UL CCN DWTT.

2.5 DUCT ACCESSORIES

A. Duct Spacers: Factory-fabricated, rigid, PVC interlocking spacers; sized for type and size of duct with which used, and selected to provide minimum duct spacing indicated while supporting duct during concreting or backfilling.

2.6 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. Performance Criteria:
1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics:
a. ASTM C858 for design and manufacturing processes.
b. SCTE 77.

B. Precast Concrete Handholes and Boxes:
1. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover must form top of enclosure and must have load rating consistent with that of handhole or box.
2. Configuration: Units must be designed for flush burial and have open bottom unless otherwise indicated.
3. Frame and Cover:
a. Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
b. Weatherproof steel frame, with steel cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
c. Weatherproof steel frame, with concealed-hinge steel access door assembly; tamper-resistant, captive, cover-securing bolts; hold-open ratchet assembly; and recessed cover handle.
d. Weatherproof aluminum frame, with concealed-hinge aluminum access door assembly; tamper-resistant, captive, cover-securing bolts; hold-open ratchet assembly; and recessed cover handle.

e. Cover Finish: Nonskid finish must have minimum coefficient of friction of 0.50.
f. Cover Legend: Molded lettering, as indicated for each service.

4. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.
   a. Extension must provide increased depth of 12 inch (300 mm).
   b. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.
5. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at installation location with ground-water level at grade.
6. Knockout Panels: Precast openings in walls, arranged to match dimensions and elevations of approaching duct, plus additional 12 inch (300 mm) vertically and horizontally to accommodate alignment variations.
   a. Center window location.
   b. Knockout panels must be located no less than 6 inch (150 mm) from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
   c. Knockout panel opening must have cast-in-place, welded-wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct.
   d. Knockout panels must be framed with at least two additional No. 3 steel reinforcing bars in concrete around each opening.
   e. Knockout panels must be 1-1/2 to 2 inch (38 to 50 mm) thick.
7. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
   a. Type and size: Match fittings to duct to be terminated.
   b. Fittings must align with elevations of approaching duct and be located near interior corners of handholes to facilitate racking of cable.
   c. Provide minimum of one cast end-bell or duct-terminating fitting of each size provided in each wall.
8. Handholes 12 inch wide by 24 inch long (300 mm wide by 600 mm long) and larger must have inserts for cable racks and pulling-in irons installed before concrete is poured.

C. Polymer Concrete Handholes and Boxes with Polymer Concrete Cover:
1. Description: Molded of sand, concrete, and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or combination.
2. Configuration: Units must be designed for flush burial and have open bottom unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and installed location.
   a. Cover Finish: Nonskid finish must have minimum coefficient of friction of 0.50.
   b. Cover Legend: Molded lettering, as indicated for each service.
4. Conduit Entrance Provisions: Conduit-terminating fittings must mate with entering ducts for secure, fixed installation in enclosure wall.
5. Duct Entrance Provisions: Duct-terminating fittings must mate with entering duct for secure, fixed installation in enclosure wall.
6. Handholes 12 inch wide by 24 inch long (300 mm wide by 600 mm long) and larger must have factory-installed inserts for cable racks and pulling-in irons.

7. Options:
   a. Color: Gray.

2.7 DUCT SEALING

A. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F (2 deg C). Compound must be capable of withstanding temperature of 300 deg F (150 deg C) without slump and adhering to clean surfaces of plastic ducts, metallic conduit, conduit and duct coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals. Duct sealing compound must be removable without damaging ducts or cables.

B. Inflatable Duct-Sealing System: Wraparound inflatable bladder that seals ducts that are empty or containing conductors against air and water infiltration. System is suitable for use in steel, plastic, or concrete ducts and penetrations.

2.8 SOURCE QUALITY CONTROL

A. Factory Tests for Handholes and Boxes:
   1. Testing Administrant: Engage qualified structural testing agency to evaluate handholes and boxes.
      a. Tests of materials must be performed by independent testing agency.
      b. Strength tests of complete boxes and covers must be by independent testing agency or manufacturer. Qualified registered professional engineer must certify tests by manufacturer.
   2. Factory Tests and Inspections: Perform the following tests and inspections on handholes and boxes, by, or under supervision of, qualified electrical testing laboratory recognized by authorities having jurisdiction, before delivering to site. Affix label with name and date of qualified testing laboratory's certification of system compliance.
      a. Precast Concrete Structures: Test and inspect in accordance with ASTM C1037.
      b. Polymer Concrete and Nonconcrete Handhole and Pull-Box Prototypes: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests must be for specified tier ratings of products supplied. Testing machine pressure gages must have current calibration certification, complying with ISO 9000 and ISO 10012, and traceable to NIST standards.
   3. Nonconforming Work:
      a. Equipment that does not pass tests and inspections will be considered defective.
   4. Factory Test Reports: Prepare and submit factory test and inspection reports

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate layout and installation of duct, duct bank, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in field. Notify Architect if there is conflict between areas of excavation and existing structures or archaeological sites to remain.

B. Coordinate elevations of duct and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of duct and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct and duct bank will drain to manholes and handholes, and as approved by Architect.

C. Clear and grub vegetation to be removed, and protect vegetation to remain in accordance with Section 311000 "Site Clearing." Remove and stockpile topsoil for reapplication in accordance with Section 311000 "Site Clearing."

3.2 SELECTION OF UNDERGROUND DUCTS

A. Duct for Electrical Cables More Than 600 V: PVC-40, concrete encased unless otherwise indicated.

B. Duct for Electrical Feeders 600 V and Less: PVC-40, concrete encased unless otherwise indicated.

C. Duct for Electrical Branch Circuits: PVC-40, direct buried unless otherwise indicated.

D. Underground Ducts Crossing Paved Paths Walks and Driveways: PVC-40.

E. Underground Ducts Crossing Roadways and Railroads: PVC-40, encased in reinforced concrete.

F. Stub-ups: Concrete encased, PVC-40.

3.3 SELECTION OF UNDERGROUND ENCLOSURES

A. Handholes and Boxes:
   1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete, AASHTO HB 17, H-20 structural load rating.
   2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Precast concrete, AASHTO HB 17, H-20 structural load rating.
   3. Units in Sidewalk and Similar Applications with Safety Factor for Nondeliberate Loading by Vehicles: Precast concrete, AASHTO HB 17, H-10 structural load rating.
   4. Units Subject to Light-Duty Pedestrian Traffic Only: , structurally tested in accordance with SCTE 77 with 3000 lbf (13 345 N) vertical loading.
   5. Cover design load must not exceed load rating of handhole or box.

3.4 EARTHWORK

A. Excavation and Backfill: Comply with Section 312000 "Earthwork," but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restoration: Restore area after construction vehicle traffic in immediate area is complete.

C. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

D. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Section 329200 "Turf and Grasses" and Section 329300 "Landscape Planting."

E. Cut and patch existing pavement in path of underground duct, duct bank, and underground structures in accordance with "Cutting and Patching" Article in Section 017300 "Execution."

3.5 INSTALLATION OF DUCTS AND DUCT BANKS

A. Reference Standards:
   1. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NEMA TCB 2 for installation of underground ducts and duct banks.
   2. Consult Architect for resolution of conflicting requirements.

B. Special Techniques:
   1. Where indicated on Drawings, install duct, spacers, and accessories into duct-bank configuration shown. Duct installation requirements in this Section also apply to duct bank.
   2. Steel raceway, bends, and fittings in on Project must be of same type.
   3. Slope: Pitch duct minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope duct from high point between two manholes to drain in both directions.
   4. Expansion and Deflection Fittings: Install expansion and deflection fitting in each duct in area of disturbed earth adjacent to manhole or handhole.
   5. Install expansion fitting near center of straight line duct with calculated expansion of more than 3/4 inch (19 mm).
   6. Curves and Bends:
      a. Use 5-degree angle couplings for small changes in direction. Use manufactured sweep bends with minimum bend radius equal or greater to four (4) times the conduit diameter, both horizontally and vertically, at other locations unless otherwise indicated.
      b. Field bending must be in accordance with NFPA 70 minimum radii requirements, except bends over 45 degrees must be made with minimum radius of 48 inch (1200 mm). Use only equipment specifically designed for

material and size involved. Use PVC heating bender for bending PVC conduit.

c. Duct must have maximum of 360 degrees of bends between pull points.

7. Joints: Use solvent-cemented joints in nonmetallic duct and fittings and make watertight in accordance with manufacturer's published instructions. Stagger couplings so those of adjacent duct do not lie in same plane. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with minimum 3 inch (75 mm) of concrete for minimum of 12 inch (300 mm) on each side of coupling.
   a. Install insulated grounding bushings on steel raceway terminations that are less than 12 inch (300 mm) below grade or floor level and do not terminate in hubs.
8. Installation Adjacent to High-Temperature Steam Lines: Where duct is installed parallel to underground steam lines, perform calculations showing duct will not be subject to environmental temperatures above 104 deg F (40 deg C). Where environmental temperatures are calculated to rise above 104 deg F (40 deg C), and anywhere duct crosses above underground steam line, install insulation blankets listed for direct burial to isolate duct bank from steam line to maintain maximum environmental temperature of 104 deg F (40 deg C).
9. End Bell Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inch (250 mm) o.c. for 5 inch (125 mm) duct, and vary proportionately for other duct sizes.
   a. Begin change from regular spacing to end-bell spacing 10 ft (3 m) from end bell, without reducing duct slope and without forming trap in line.
   b. Grout end bells into structure walls from both sides to provide watertight entrances.
10. Duct Terminators for Entrances to Cast-in-Place Manholes and Concrete Handholes: Use manufactured, cast-in-place duct terminators, with entrances into structure spaced approximately 6 inch (150 mm) o.c. for 4 inch (100 mm) duct, and vary proportionately for other duct sizes.
    a. Begin change from regular spacing to terminator spacing 10 ft (3 m) from terminator, without reducing duct line slope and without forming trap in line.
11. Building Wall Penetrations: Make transition from underground duct to steel raceway at least 10 ft (3 m) outside building wall, without reducing duct line slope away from building and without forming trap in line. Use fittings manufactured for transition to steel raceway type installed. Install steel raceway penetrations of building walls as specified in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
12. Sealing: Provide temporary closure at terminations of duct with pulled cables. Seal spare duct at terminations. Use sealing compound and plugs to withstand at least 15 psig (1.03 MPa) hydrostatic pressure.
13. Pulling Cord: Install 200 lbf (1000 N) test nylon cord in empty ducts.
14. Concrete-Encased Ducts and Duct Bank:
    a. Excavate trench bottom to provide firm and uniform support for duct. Prepare trench bottoms as specified in Section 312000 "Earthwork" for pipes 6 inch (150 mm) or less in nominal diameter.
    b. Width: Excavate trench 3 inch (75 mm) wider than duct on each side.
    c. Depth: Install so top of duct envelope is at least 24 inch (600 mm) below finished grade in areas not subject to deliberate traffic, and at least 30 inch

(750 mm) below finished grade in deliberate traffic paths for vehicles unless otherwise indicated. Install so top of duct envelope is below local frost line.

d. Support duct on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.

e. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than four spacers per 20 ft (6 m) of duct. Place spacers within 24 inch (600 mm) of duct ends. Stagger spacers approximately 6 inch (150 mm) between tiers. Secure spacers to earth and to duct to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.

f. Minimum Space between Ducts: 3 inch (75 mm) between edge of duct and exterior envelope wall, 2 inch (50 mm) between ducts for like services, and 4 inch (100 mm) between power and communications ducts.

g. Elbows:
   1) Use manufactured duct elbows for stub-ups and at changes of direction in duct unless otherwise indicated. Extend encasement throughout length of elbow.
   2) Use manufactured steel elbows for stub-ups, at building entrances, and at changes of direction in duct run.

h. Stub-ups to Outdoor Equipment: Extend concrete-encased steel raceway horizontally minimum of 60 inch (1500 mm) from edge of equipment base.
   1) Stub-ups must be minimum 4 inch (100 mm) above finished floor and minimum 3 inch (75 mm) from conduit side to edge of slab.

i. Stub-ups to Indoor Equipment: Extend concrete-encased steel raceway horizontally minimum of 60 inch (1500 mm) from edge of wall. Install insulated grounding bushings on terminations at equipment.
   1) Stub-ups must be minimum 4 inch (100 mm) above finished floor and no less than 3 inch (75 mm) from conduit side to edge of slab.

j. Reinforcement: Reinforce concrete-encased duct where crossing disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.

k. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.

l. Concrete Cover: Install minimum of 3 inch (75 mm) of concrete cover between edge of duct to exterior envelope wall, 2 inch (50 mm) between duct of like services, and 4 inch (100 mm) between power and communications ducts.

m. Place minimum 6 inch (150 mm) of engineered fill above concrete encasement of duct.

n. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
   1) Start at one end and finish at other, allowing for expansion and contraction of duct as its temperature changes during and after pour. Use expansion fittings installed in accordance with manufacturer's published instructions, or use other specific measures to prevent expansion-contraction damage.
   2) If more than one pour is necessary, terminate each pour in vertical plane and install 3/4 inch (15 mm) reinforcing-rod dowels extending

minimum of 18 inch (450 mm) into concrete on both sides of joint near corners of envelope.

o. Pouring Concrete: Comply with requirements in "Concrete Placement" Article in Section 033000 "Cast-in-Place Concrete." Place concrete carefully during pours to prevent voids under and between duct and at exterior surface of envelope. Do not allow heavy mass of concrete to fall directly onto ducts. Allow concrete to flow around duct and rise up in middle, uniformly filling open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-installation application.

15. Underground-Line Warning Tape: Bury nonconducting underground line specified in Section 260553 "Identification for Electrical Systems" no less than 12 inch (300 mm) above concrete-encased duct and duct banks and approximately 12 inch (300 mm) below grade. Align tape parallel to and within 3 inch (75 mm) of centerline of duct bank. Provide additional warning tape for each 12 inch (300 mm) increment of duct-bank width over nominal 18 inch (450 mm). Space additional tapes 12 inch (300 mm) apart, horizontally across width of ducts.
16. Ground ducts and duct banks in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

3.6 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

A. Reference Standards:
1. Precast Concrete Handholes: Comply with ASTM C891 unless otherwise indicated.
2. Consult Architect for resolution of conflicting requirements.

B. Special Techniques:
1. Cast-in-Place Manholes:
   a. Finish interior surfaces with smooth-troweled finish.
   b. Knockouts for Future Duct Connections: Form and pour concrete knockout panels 1-1/2 to 2 inch (38 to 50 mm) thick, arranged as indicated.
   c. Comply with requirements in Section 033000 "Cast-in-Place Concrete" for cast-in-place concrete, formwork, and reinforcement.
2. Precast Concrete Handholes and Manholes:
   a. Install units level and plumb and with orientation and depth coordinated with connecting duct to minimize bends and deflections required for proper entrances.
   b. Unless otherwise indicated, support units on level bed of crushed stone or gravel graded from 1 inch (25 mm) sieve to No. 4 (4.75 mm) sieve and compacted to same density as adjacent undisturbed earth.
   c. Field-cut openings for conduits in accordance with enclosure manufacturer's published instructions. Cut wall of enclosure with tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
3. Elevations:
   a. Manhole Roof: Install with rooftop at least 15 inch (375 mm) below finished grade.
   b. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch (25 mm) above finished grade.
   c. Install handholes with bottom below frost line, below grade.

d. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.
e. Where indicated, cast handhole cover frame integrally with handhole structure.

4. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.
5. Manhole Access: Circular opening in manhole roof; sized to match cover size.
   a. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.
   b. Install chimney, constructed of precast concrete collars and rings, and cast-iron frame to connect cover with manhole roof opening. Provide moisture-tight joints and waterproof grouting for frame and chimney.
6. Hardware: Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.
7. Fixed Manhole Ladders: Arrange to provide for safe entry with maximum clearance from cables and other items in manholes.
8. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inch (97 mm) for manholes and 2 inch (50 mm) for handholes, for anchor bolts installed in field. Use minimum of two anchors for each cable stanchion.
9. Ground manholes, handholes, and boxes in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

3.7 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Special Techniques:
1. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of duct, and seal joint between box and extension as recommended by manufacturer.
2. Unless otherwise indicated, support units on level bed of crushed stone or gravel, graded from 1/2 inch (12.5 mm) sieve to No. 4 (4.75 mm) sieve and compacted to same density as adjacent undisturbed earth.
3. Elevation: In paved areas and trafficways, set cover flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.
4. Install handholes and boxes with bottom below frost line, below grade.
5. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.
6. Field cut openings for duct in accordance with enclosure manufacturer's published instructions. Cut wall of enclosure with tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
7. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour concrete ring encircling,

and in contact with enclosure entry, and with top surface screeded to top of box cover frame. Bottom of ring must rest on compacted earth.
   a. Concrete: 3000 psi (20 kPa), 28-day strength, complying with Section 033000 "Cast-in-Place Concrete," with troweled finish.
   b. Dimensions: 10 inch wide by 12 inch deep (250 mm wide by 300 mm deep).
8. Ground handholes and boxes in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

3.8 FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. Demonstrate capability and compliance with requirements on completion of installation of underground duct, duct bank, and manhole structures.
   2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide minimum 12 inch (300 mm) long mandrel equal to duct size minus 1/4 inch (6 mm). If obstructions are indicated, remove obstructions and retest.
   3. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 260526 "Grounding and Bonding for Electrical Systems."

B. Nonconforming Work:
   1. Underground ducts, raceways, and structures will be considered defective if they do not pass tests and inspections.
   2. Correct deficiencies and retest as specified above to demonstrate compliance.

C. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.

D. Manufacturer Services: Engage factory-authorized service representative to support field tests and inspections.
   1. Manufacturer's Field Reports for Field Quality-Control Support: Prepare and submit report after each visit by factory-authorized service representative, documenting activities performed at Project site.

3.9 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of duct until duct cleaner indicates that duct is clear of dirt and debris. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of manholes, including sump, and building interiors affected by Work.
   1. Sweep floor, removing dirt and debris.
   2. Remove foreign material.

END OF SECTION

SECTION 260544 – SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Round sleeves.
2. Rectangular sleeves.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.
6. Pourable sealants.
7. Foam sealants.

B. Related Requirements:
1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. 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.

PART 2 - PRODUCTS

2.1 ROUND SLEEVES

A. Steel Wall Sleeves:
1. General Characteristics: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends and integral waterstop.

B. Cast-Iron Wall Sleeves:
1. General Characteristics: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop.

C. PVC Pipe Sleeves:
1. General Characteristics: ASTM D1785, Schedule 40.

D. PVC Molded Sleeves:
1. General Characteristics: With nailing flange for attaching to wooden forms.

E. PE or PP Molded Sleeves:

1. General Characteristics: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

F. Round, Galvanized-Steel, Sheet Metal Sleeves:
1. General Characteristics: Galvanized-steel sheet; thickness not less than 0.0239 inch (0.6 mm); round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

2.2 RECTANGULAR SLEEVES

A. Rectangular, Galvanized-Steel, Sheet Metal Sleeves:
1. General Characteristics:
a. Material: Galvanized sheet steel.
b. Minimum Metal Thickness:
1) For sleeve cross-section rectangle perimeter less than 50 inch (1270 mm) and with no side larger than 16 inch (400 mm), thickness must be 0.052 inch (1.3 mm).
2) For sleeve cross-section rectangle perimeter not less than 50 inch (1270 mm) or with one or more sides larger than 16 inch (400 mm), thickness must be 0.138 inch (3.5 mm).

2.3 SLEEVE-SEAL SYSTEMS

A. General Characteristics: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable or between raceway and cable.

B. Options:
1. Sealing Elements: Nitrile (Buna N) rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. General Characteristics: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit must have plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

A. General Characteristics: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
1. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
2. Design Mix: 5000 psi (34.5 MPa), 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.6 POURABLE SEALANTS

A. Performance Criteria:
1. General Characteristics: Single-component, neutral-curing elastomeric sealants of grade indicated below.
a. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

2.7 FOAM SEALANTS

A. Performance Criteria:
1. General Characteristics: Multicomponent, liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam. Foam expansion must not damage cables or crack penetrated structure.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. 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 space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor so no voids remain. Tool exposed surfaces smooth; protect material while curing.
b. 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."
2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4 inch (6.4 mm) annular clear space between sleeve and raceway or cable, unless sleeve-seal system is to be installed or 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 inch (50 mm) above finished floor level. Install sleeves during erection of floors.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Wall Assemblies:
1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for wall assemblies.

C. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

D. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve-seal systems. Size sleeves to allow for 1 inch (25 mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

E. Underground, Exterior-Wall and Floor Penetrations:
   1. Install steel pipe sleeves with integral waterstops. Size sleeves to allow for 1 inch (25 mm) annular clear space between raceway or cable and sleeve for installing sleeve-seal system. Install sleeve during construction of floor or wall.
   2. Install steel pipe sleeves. Size sleeves to allow for 1 inch (25 mm) annular clear space between raceway or cable and sleeve for installing sleeve-seal system. Grout sleeve into wall or floor opening.

3.2 INSTALLATION OF RECTANGULAR SLEEVES AND SLEEVE SEALS

A. Install sleeves in existing walls without compromising structural integrity of walls. Do not cut structural elements without reinforcing the wall to maintain the designed weight bearing and wall stiffness.

B. Install conduits and cable with no crossings within the sleeve.

C. Fill opening around conduits and cables with expanding foam without leaving voids.

D. Provide metal sheet covering at both wall surfaces and finish to match surrounding surfaces. Metal sheet must be same material as sleeve.

3.3 INSTALLATION OF SLEEVE-SEAL SYSTEMS

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.

END OF SECTION

SECTION 260548 – VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Elastomeric isolation pads.
2. Restraints - rigid type.
3. Restraints - cable type.
4. Restraint accessories.
5. Post-installed concrete anchors.
6. Concrete inserts.

B. Related Requirements:
1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260529 "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.

1.2 ACTION SUBMITTALS

A. Product Data:
1. Elastomeric isolation pads.
2. Restraints - rigid type.
3. Restraints - cable type.
4. Restraint accessories.
5. Post-installed concrete anchors.
6. Concrete inserts.

B. Shop Drawings:
1. Detail fabrication and assembly of equipment bases.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
3. Show coordination of seismic and wind-load bracing for components with other systems and equipment in the vicinity, including other supports and seismic restraints.

C. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage qualified structural professional engineer to design seismic and wind-load control system in accordance with criteria specified in Section 260010 "Supplemental Requirements for Electrical" and Section 260011 "Facility Performance Requirements for Electrical."

B. Seismic- and Wind-Load-Restraint Device Load Ratings: Devices to be tested and rated in accordance with applicable code requirements and authorities having jurisdiction. Devices to be listed by a nationally recognized third party that requires periodic follow-up inspections and has a listing directory available to the public. Provide third-party listing by one or more of the following: ICC-ES product listing, UL product listing or an agency acceptable to authorities having jurisdiction.

C. Consequential Damage: Provide additional seismic and wind-load restraints for suspended components or anchorage of floor-, roof-, or wall-mounted components so that failure of a non-essential or essential component will not cause failure of any other essential building component.

D. Fire/Smoke Resistance: Seismic- and wind-load-restraint devices that are not constructed of ferrous metals must have a maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested by qualified testing laboratory in accordance with ASTM E84 or UL 723, and be so labeled.

E. Component Supports:
   1. Load ratings, features, and applications of reinforcement components must be based on testing standards of qualified testing laboratory.

2.2 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads:
   1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
   2. Size: Factory or field cut to match requirements of supported equipment.
   3. Pad Material: Oil and water resistant with elastomeric properties. Neoprene rubber, silicone rubber, or other elastomeric material.
   4. Surface Pattern: Smooth, ribbed, or waffle pattern.
   5. Infused nonwoven cotton or synthetic fibers.
   6. Load-bearing metal plates adhered to pads.
   7. Sandwich-Core Material: Resilient and elastomeric.
      a. Surface Pattern: Smooth, ribbed, or waffle pattern.
      b. Infused nonwoven cotton or synthetic fibers.

2.3 RESTRAINTS - RIGID TYPE

A. Description: Shop- or field-fabricated bracing assembly made of ANSI/AISI S110-07-S1 slotted steel channels, ANSI/ASTM A53/A53M steel pipe, or other rigid steel brace

member. Includes 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; rated in tension, compression, and torsion forces.

2.4 RESTRAINTS - CABLE TYPE

A. Seismic- and Wind-Load-Restraint Cables: ASTM A1023/A1023M galvanized or ASTM A603 galvanized-steel or ASTM A492 stainless steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for seismic-restraining cable service; with fittings attached by means of poured socket, swaged socket, or mechanical (Flemish eye) loop.

B. Restraint cable assembly and cable fittings must comply with ASCE/SEI 19. Cable fittings and complete cable assembly must maintain the minimum cable breaking force. U-shaped cable clips and wedge-type end fittings do not comply and are unacceptable.

2.5 RESTRAINT ACCESSORIES

A. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod. Non-metallic stiffeners are unacceptable.

B. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings.

C. 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.

D. 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.

E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.6 POST-INSTALLED CONCRETE ANCHORS

A. Mechanical Anchor Bolts:
1. 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 for anchor and as tested according to ASTM E488/E488M.

B. Adhesive Anchor Bolts:
1. Drilled-in and capsule anchor system containing PVC 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 E488/E488M.

C. Provide post-installed concrete anchors that have been prequalified for use in seismic and wind-load applications.
   1. Prequalify post-installed anchors in concrete in accordance with ACI 355.2 or other approved qualification testing procedures.
   2. Prequalify post-installed anchors in masonry in accordance with approved qualification procedures.

D. Expansion-type anchor bolts are not permitted for equipment in excess of 10 hp (7.46 kW) that is not vibration isolated.
   1. Undercut expansion anchors are permitted.

2.7 CONCRETE INSERTS

A. Provide preset concrete inserts that are seismically prequalified in accordance with ICC-ES AC446 testing.

B. Comply with MSS SP-58.

2.8 SOURCE QUALITY CONTROL

A. Product Data: Prepare and submit catalog cuts, brochures, diagrams, and performance data illustrating size, physical appearance, and other characteristics of product.
   1. Include rated load capacity for each seismic- and wind-load-restraint device.
   2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic- and wind-load-restraint component used.
   3. Annotate types and sizes of seismic restraints and accessories, complete with listing markings or report numbers and load rating in tension and compression as evaluated by ICC-ES product listing, OSHPD or an agency acceptable to authorities having jurisdiction.
   4. Annotate to indicate application of each product submitted and compliance with requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive seismic and wind-load control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for 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 Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an evaluation service member of ICC-ES, OSHPD or an agency acceptable to authorities having jurisdiction.

B. Hanger-Rod Stiffeners: Install where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods caused by seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry static, wind load, and seismic loads within specified loading limits.

3.3 INSTALLATION OF SEISMIC-RESTRAINT AND WIND-LOAD CONTROL DEVICES

A. Provide seismic restraint and wind-load control devices for systems and equipment where indicated in Equipment Schedules or Seismic and Wind-Load Controls Schedule, where indicated on Drawings, where the Specifications indicate they are to be installed on specific equipment and systems, and where required by applicable codes.
   1. Install equipment and devices to withstand the effects of earthquake motions and high wind events.

B. Coordinate location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

C. Installation of seismic and wind-load restraints must not cause any stresses, misalignment, or change of position of equipment or conduits.

D. Equipment Restraints:
   1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
   2. Install seismic-restraint and wind-load-restraint devices using methods approved by an evaluation service member of ICC-ES, OSHPD or an agency acceptable to authorities having jurisdiction that provides required submittals for component.

E. Raceway, Cable, Wireway, Cable Tray, and Busway Support and Hanger Restraints:
   1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
   2. Install seismic-restraint and wind-load-restraint devices using methods approved by an evaluation service member of ICC-ES, OSHPD or an agency acceptable to authorities having jurisdiction that provides required submittals for component.
   3. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
   4. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES, OSHPD or an agency acceptable to authorities having jurisdiction that provides required submittals for component.

F. Install cables so they do not bend across edges of adjacent equipment or building structure.

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. Post-Installed Concrete 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 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. Mechanical-Type Anchor Bolts: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors must be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive-Type Anchor Bolts: 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 runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where connection is terminated to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.5 FIELD QUALITY CONTROL

A. Field tests must be witnessed by authorities having jurisdiction.

B. Tests and Inspections:
1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless 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 no fewer than 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.

C. Nonconforming Work:
1. Seismic controls will be considered defective if they do not pass tests and inspections.
2. Remove and replace malfunctioning units and retest as specified above.

D. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.

END OF SECTION

SECTION 260553 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Labels.
2. Extruded insulating tubing.
3. Bands.
4. Tapes and stencils.
5. Tags.
6. Signs.
7. Cable ties.

B. Related Requirements:
1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule: For each piece of electrical equipment and electrical system components to be index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

PART 2 - PRODUCTS

2.1 LABELS

A. Performance Criteria:
1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN PGDQ2 for components; including UL 969.

B. UL PGDQ2 - Vinyl Wraparound Labels: Preprinted, flexible labels laminated with clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

C. UL PGDQ2 - Self-Adhesive Wraparound Labels: Preprinted, 3 mil (0.08 mm) thick, vinyl flexible label with acrylic pressure-sensitive adhesive.
   1. Self-Lamination: Clear; UV-, weather-, and chemical-resistant; self-laminating, with protective shield over legend. Size labels such that clear shield overlaps entire printed legend.
   2. Marker for Labels:
      a. Permanent, waterproof, black ink marker recommended by tag manufacturer.
      b. Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

D. UL PGDQ2 - Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3 mil (0.08 mm) thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
   1. Minimum Nominal Size:
      a. 1-1/2 by 6 inch (37 by 150 mm) for raceway and conductors.
      b. 3-1/2 by 5 inch (76 by 127 mm) for equipment.
      c. As required by authorities having jurisdiction.

2.2 EXTRUDED INSULATING TUBING

A. Performance Criteria:
   1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
   2. Listing Criteria: UL CCN YDPU2 for components; including UL 224.

B. UL YDPU2 - Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at maximum of 200 deg F (93 deg C).

2.3 BANDS

A. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.

B. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inch (50 mm) long, with diameters sized to suit diameters and that stay in place by gripping action.

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.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mil (0.08 mm) thick by 1 to 2 inch (25 to 50 mm) wide; compounded for outdoor use.

C. Tape and Stencil: 4 inch (100 mm) wide black stripes on 10 inch (250 mm) centers placed diagonally over orange background and are 12 inch (300 mm) wide. Stop stripes at legends.

D. Floor Marking Tape: 2 inch (50 mm) wide, 5 mil (0.125 mm) pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

E. Underground-Line Warning Tape:
   1. Tape:
      a. Recommended by manufacturer for method of installation and suitable to identify and locate underground electrical lines.
      b. Printing on tape must be permanent and may not be damaged by burial operations.
      c. Tape material and ink must be chemically inert and not be subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
   2. Color and Printing:
      a. Comply with APWA Uniform Color Code using NEMA Z535.1 safety colors.
      b. Inscriptions for Red Tapes: "CAUTION BURIED ELECTRIC LINE BELOW".
      c. Inscriptions for Orange Tapes: "CAUTION BURIED COMMUNICATION LINE BELOW".
   3. Reinforced Detectable Line-Warning Tape:
      a. Reinforced, detectable three-layer laminate, consisting of printed pigmented woven scrim, solid aluminum-foil core, and clear protective film that allows inspection of continuity of conductive core; bright-colored, continuous-printed on one side with inscription of utility, compounded for direct-burial service.
      b. Width: 3 inch (75 mm).
      c. Overall Thickness: 8 mil (0.2 mm).
      d. Foil Core Thickness: 0.35 mil (8.9 m).
      e. Weight: 34 lb/1000 sq. ft (16.6 kg/100 sq. m).
      f. Tensile in accordance with ASTM D882: 300 lbf (1334 N) and 12,500 psi (86.1 MPa).

F. Stenciled Legend: In nonfading, waterproof, black ink, or paint. Minimum letter height must be 1 inch (25 mm).

2.5 TAGS

A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking cable tie fastener.

B. Nonmetallic Preprinted Tags: Polyethylene tags, 0.015 inch (0.38 mm) thick, color-coded for phase and voltage level, with factory printed permanent designations; punched for use with self-locking cable tie fastener.

C. Write-on Tags:
   1. Polyester Tags: 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and cable tie for attachment.
   2. Marker for Tags:

a. Permanent, waterproof, black ink marker recommended by tag manufacturer.
b. 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 (6.4 mm) grommets in corners for mounting.
3. Nominal Size: 7 by 10 inch (180 by 250 mm).

B. Metal-Backed Butyrate Signs:
1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396 inch (1 mm) galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
2. 1/4 inch (6.4 mm) grommets in corners for mounting.
3. Nominal Size: 10 by 14 inch (250 by 360 mm).

C. Laminated Acrylic or Melamine Plastic Signs:
1. Engraved legend.
2. Thickness:
a. For signs up to 20 sq. inch (129 sq. cm), minimum 1/16 inch (1.6 mm) thick.
b. For signs larger than 20 sq. inch (129 sq. cm), 1/8 inch (3.2 mm) thick.
c. Engraved legend with white letters on black face for equipment powered by the normal power system and white letters on red face for emergency power system.
d. Punched or drilled for mechanical fasteners with 1/4 inch (6.4 mm) grommets in corners for mounting.
e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.7 CABLE TIES

A. Performance Criteria:
1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria: UL CCN ZODZ; including UL 1565 or UL 62275.

B. UL ZODZ - General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C) in accordance with ASTM D638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black, except where used for color-coding.

C. UL ZODZ - UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
   1. Minimum Width: 3/16 inch (5 mm).
   2. Tensile Strength at 73 deg F (23 deg C) in accordance with ASTM D638: 12,000 psi (82.7 MPa).
   3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
   4. Color: Black.

D. UL ZODZ - Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
   1. Minimum Width: 3/16 inch (5 mm).
   2. Tensile Strength at 73 deg F (23 deg C) in accordance with ASTM D638: 7000 psi (48.2 MPa).
   3. UL 94 Flame Rating: 94V-0.
   4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
   5. Color: Black.

PART 3 - EXECUTION

3.1 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 SELECTION OF COLORS AND IDENTIFICATION MARKINGS

A. Comply with 29 CFR 1910.144 for color identification of hazards, and the following:
   1. Fire-protection and fire-alarm equipment, including raceways, must be finished, painted, or suitably marked safety red.
   2. Ceiling-mounted hangers, supports, cable trays, and raceways must be finished, painted, or suitably marked safety yellow where less than 7.7 ft (2.3 m) above finished floor.

B. Pipe and Conduit Labeling: Comply with ASME A13.1 and IEEE C2.

C. Color-Coding for Phase- and Voltage-Level Identification, 1000 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
   1. Color must be factory applied or field applied for sizes larger than 6 AWG when permitted by authorities having jurisdiction.
   2. Colors for 208Y/120 V Circuits:
      a. Phase A: Black.
      b. Phase B: Red.
      c. Phase C: Blue.
   3. Colors for 240 V Circuits:
      a. Phase A: Black.
      b. Phase B: Red.
   4. Colors for 480Y/277 V Circuits:
      a. Phase A: Brown.

b. Phase B: Orange.
c. Phase C: Yellow.

5. Color for Neutral (Grounded Conductor): White or gray.
6. Color for Equipment Ground: Green.
7. Color for Isolated Ground: Green with two or more yellow stripes.

D. Color-Coding Raceways, Cable Trays, Junction Boxes, and Conductors for Intrinsically-Safe Circuits: Light blue. When used to identify intrinsically-safe circuits, Article 504 of NFPA 70 requires that the color light blue not be used for any other purpose.

E. Color-Coding Instructional Signs: Self-adhesive labels, including color code for grounded and ungrounded conductors.

F. Accessible Fittings for Raceways: Identify cover of junction and pull box of the following systems with wiring system legend and system voltage. System legends must be as follows:
1. "EMERGENCY POWER."
2. "POWER."

G. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

H. Locations of Underground Lines: Underground-line warning tape for power and lighting.

I. Vaults, Manholes, Handholes, and Pull and Junction Boxes, More Than 1000 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic preprinted tags colored and marked to indicate phase, and separate tag with circuit designation.

J. Vaults, Manholes, Handholes, and Pull and Junction Boxes, 1000 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use self-adhesive wraparound labels to identify phase.
1. Locate identification at changes in direction, at penetrations of walls and floors, at 50 ft (15 m) maximum intervals in straight runs, and at 25 ft (7.6 m) maximum intervals in congested areas.
2. Identify system voltage and system or service type with black letters on white field.

K. Accessible Raceways and Metal-Clad Cables, 1000 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.
1. Locate identification at changes in direction, at penetrations of walls and floors, at 50 ft (15 m) maximum intervals in straight runs, and at 25 ft (7.6 m) maximum intervals in congested areas.
2. Identify system voltage and system or service type with black letters on white field.

L. Cover Plates: Label individual cover plates with self-adhesive labels. Place label at top of cover plate. Label cover plate with the following information, in the order listed:
1. Panelboard designation.

2. Colon or dash.
3. Branch circuit number.

M. Equipment Identification Labels:
1. Black letters on white field.
2. Indoor Equipment: Laminated acrylic or melamine sign.
3. Outdoor Equipment: Laminated acrylic or melamine sign.
4. Equipment to Be Labeled:
   a. Racks, Frames, and Enclosures: Identify front and rear of each with self-adhesive labels containing equipment designation.
   b. Panelboards: Typewritten directory of circuits in location provided by panelboard manufacturer. Panelboard identification must be in form of laminated acrylic or melamine label.
   c. Enclosures and electrical cabinets.
   d. Access doors and panels for concealed electrical items.
   e. Switchboards.
   f. Transformers: Label that includes tag designation indicated on Drawings for transformer, feeder, and panelboards or equipment supplied by secondary.
   g. Emergency system boxes and enclosures.
   h. Enclosed switches.
   i. Enclosed circuit breakers.
   j. Power-transfer equipment.
   k. Power-generating units.
   l. Monitoring and control equipment.

N. Cable Ties: General purpose, for attaching tags, except as listed below:
1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.3 SELECTION OF SIGNS AND HAZARD MARKINGS

A. Comply with 29 CFR 1910.145 for danger, caution, warning, and safety instruction signs.

B. Signs, labels, and tags required for personnel safety must comply with the following standards:
1. Safety Colors: NEMA Z535.1.
2. Facility Safety Signs: NEMA Z535.2.
3. Safety Symbols: NEMA Z535.3.
4. Product Safety Signs and Labels: NEMA Z535.4.
5. Safety Tags and Barricade Tapes for Temporary Hazards: NEMA Z535.5.

C. Electrical Hazard Warnings:
1. Arc-Flash Hazard Warning: Self-adhesive labels. Comply with NFPA 70E and Section 260573.19 "Arc-Flash Hazard Analysis" requirements for arc-flash hazard warning labels.
2. Raceways and Cables Carrying Circuits at More Than 1000 V:
   a. Black letters on orange field.
   b. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."

3. Multiple Power Sources Warning Legend: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

D. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs.
1. Apply to exterior of door, cover, or other access.
2. 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.

E. Operating Instruction Signs: Laminated acrylic or melamine plastic signs.

F. Emergency Operating Instruction Signs: Laminated acrylic or melamine plastic signs with white legend on red background with minimum 3/8 inch (10 mm) high letters for emergency instructions at equipment used for power transfer or load shedding.

3.4 INSTALLATION

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes typical for electrical equipment environments specified in Section 260011 "Facility Performance Requirements for Electrical."

C. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

D. Fasteners for Labels and Signs: Self-tapping, stainless steel screws or stainless steel machine screws with nuts and flat and lock washers.

E. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

F. Install identifying devices before installing acoustical ceilings and similar concealment.

G. Verify identity of item before installing identification products.

H. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

I. Apply identification devices to surfaces that require finish after completing finish work.

J. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

K. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from floor.

L. Vinyl Wraparound Labels:
1. Secure tight to surface of raceway or cable at location with high visibility and accessibility.
2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to location and substrate.

M. Snap-Around Labels: Secure tight to surface at location with high visibility and accessibility.

N. Self-Adhesive Wraparound Labels: Secure tight to surface at location with high visibility and accessibility.

O. Snap-Around Color-Coding Bands: Secure tight to surface at location with high visibility and accessibility.

P. Heat-Shrink, Preprinted Tubes: Secure tight to surface at location with high visibility and accessibility.

Q. Marker Tapes: Secure tight to surface at location with high visibility and accessibility.

R. Self-Adhesive Vinyl Tape: Secure tight to surface at location with high visibility and accessibility.
1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for minimum distance of 6 inch (150 mm) where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

S. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

T. Underground Line Warning Tape:
1. During backfilling of trenches, install continuous underground-line warning tape not less than 12 inch (300 mm) directly above cables or raceways buried 18 inch (450 mm) or more below grade. Use multiple tapes where width of multiple lines installed in common trench or concrete envelope exceeds 16 inch (400 mm) overall.
2. Install underground-line warning tape for direct-buried cables and cables in raceways.

U. Metal Tags:
1. Place in location with high visibility and accessibility.
2. Secure using UV-stabilized cable ties.

V. Nonmetallic Preprinted Tags:
1. Place in location with high visibility and accessibility.
2. Secure using UV-stabilized cable ties.

W. Write-on Tags:
1. Place in location with high visibility and accessibility.
2. Secure using UV-stabilized cable ties.

X. Baked-Enamel Signs: Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.

Y. Metal-Backed Butyrate Signs: Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.

Z. Laminated Acrylic or Melamine Plastic Signs: Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.

END OF SECTION

SECTION 260573.13 – SHORT-CIRCUIT STUDIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Computer-based, fault-current study to determine minimum interrupting capacity of circuit protective devices.

B. Related Requirements:
1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260573.16 "Coordination Studies" for overcurrent protective device coordination studies.
3. Section 260573.19 "Arc-Flash Hazard Analysis" for arc-flash studies.

1.2 ACTION SUBMITTALS

A. Product Data:
1. For power system analysis software to be used for studies.

B. Short-Circuit Study Report:
1. Submit the following after approval of system protective devices submittals. Submittals may be in digital form.
   a. Short-circuit study input data, including completed computer program input data sheets.
   b. Submit study report for action prior to receiving final approval of 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 selection of devices and associated characteristics is satisfactory.
   c. Revised one-line diagram, reflecting field investigation results and results of short-circuit study.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For short-circuit study software, certifying compliance with IEEE 399.

1.4 QUALITY ASSURANCE

A. Study must be performed using commercially developed and distributed software designed specifically for power system analysis.

B. Software algorithms must comply with requirements of standards and guides specified in this Section.

C. Manual calculations are unacceptable.

PART 2 - PRODUCTS

2.1 POWER SYSTEM ANALYSIS SOFTWARE

A. Subject to compliance with additional requirements, provide power systems study using:
1. PowerTools for Windows (PTW32)
2. Etap Power System Analysis
3. Approved equal.

B. Comply with IEEE 399 and IEEE 551.

C. Analytical features of power systems analysis software program must have capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

D. Computer software program must be capable of plotting and diagramming time-current-characteristic curves as part of their output.

E. Computer program must be designed to perform short-circuit studies or have function, component, or add-on module designed to perform short-circuit studies.

F. Computer program must be developed under supervision of licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

2.2 SHORT-CIRCUIT STUDY REPORT CONTENTS

A. Executive summary of study findings.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.

C. One-line diagram of modeled power system, showing the following:
1. Protective device designations and ampere ratings.
2. Conductor types, sizes, and lengths.
3. Transformer kVA and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, and panelboard designations and ratings.
6. Derating factors and environmental conditions.
7. Any revisions to electrical equipment required by study.

D. Comments and recommendations for system improvements or revisions in written document, separate from one-line diagram.

E. Protective Device Evaluation:
   1. Evaluate equipment and protective devices and compare to available short-circuit currents. Verify that equipment withstand ratings exceed available short-circuit current at equipment installation locations.
   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 standards to 1/2-cycle symmetrical fault current.
   5. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

F. Short-Circuit Study Input Data:
   1. One-line diagram of system being studied.
   2. Power sources available.
   3. Manufacturer, model, and interrupting rating of protective devices.
   4. Conductors.
   5. Transformer data.

G. Short-Circuit Study Output Reports:
   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 symmetrical basis.
      g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on total basis.

PART 3 - EXECUTION

3.1 POWER SYSTEM DATA

A. Obtain data necessary for conduct of study.
   1. Verify completeness of data supplied on one-line diagram. Call discrepancies to Architect's attention.
   2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.
   3. For equipment that is existing to remain, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers in accordance with NFPA 70E.

B. Gather and tabulate required input data to support short-circuit study. Comply with requirements in Section 017839 "Project Record Documents" for recording circuit protective device characteristics. Record data on Record Document copy of one-line diagram. Comply with recommendations in IEEE 551 as to amount of detail that is required to be acquired in field. Field data gathering must be by, or under supervision of, qualified electrical professional engineer. Data include, but are not limited to, the following:
   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 impedance at 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. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
   8. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
   9. Motor horsepower and NEMA MG 1 code letter designation.
   10. Conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
   11. Derating factors.

3.2 SHORT-CIRCUIT STUDY

A. Perform study following general study procedures contained in IEEE 399.

B. Calculate short-circuit currents according to IEEE 551.

C. Base study on device characteristics supplied by device manufacturer.

D. Extent of electrical power system to be studied is indicated on Drawings.

E. Begin short-circuit current analysis at service, extending down to system overcurrent protective devices as follows:
   1. To normal system low-voltage load buses where fault current is 5 kA or less.
   2. Exclude equipment supplied by single transformer smaller than 75 kVA.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. Include ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase ac systems. Also account for fault-current dc decrement to address asymmetrical requirements of interrupting equipment.

H. Calculate short-circuit momentary and interrupting duties for three-phase bolted fault and single line-to-ground fault at each equipment indicated on one-line diagram.
   1. For grounded systems, provide bolted line-to-ground fault-current study for areas as defined for three-phase bolted fault short-circuit study.

I. Include in report identification of protective device applied outside its capacity.

END OF SECTION

SECTION 260573.16 – COORDINATION STUDIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.
      a. Study results must be used to determine coordination of series-rated devices.

B. Related Requirements:
   1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
   2. Section 260573.13 "Short-Circuit Studies" for fault-current studies.
   3. Section 260573.19 "Arc-Flash Hazard Analysis" for arc-flash studies.

1.2 ACTION SUBMITTALS

A. Product Data:
   1. For power system analysis software to be used for studies.

B. Coordination Study Report:
   1. Submit the following after approval of system protective devices submittals. Submittals may be in digital form.
      a. Coordination-study input data, including completed computer program input data sheets.
      b. Study and equipment evaluation reports.
      c. Submit study report for action prior to receiving final approval of 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 selection of devices and associated characteristics is satisfactory.
      d. Revised one-line diagram, reflecting field investigation results and results of coordination study.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For overcurrent protective device coordination study software, certifying compliance with IEEE 399.

1.4 QUALITY ASSURANCE

A. Studies must be performed using commercially developed and distributed software designed specifically for power system analysis.

B. Software algorithms must comply with requirements of standards and guides specified in this Section.

C. Manual calculations are unacceptable.

1.5 REGULATORY AGENCY APPROVALS

A. Submittals for coordination study requiring approval by authorities having jurisdiction must be signed and sealed by qualified electrical professional engineer responsible for their preparation.

B. Submittals for coordination study require action by Architect prior to submitting for approval by authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 POWER SYSTEM ANALYSIS SOFTWARE

A. Subject to compliance with additional requirements, provide power systems study using:
1. PowerTools for Windows (PTW32)
2. Etap Power System Analysis
3. Approved equal.

B. Comply with IEEE 242 and IEEE 399.

C. Analytical features of device coordination study computer software program must have capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

D. Computer software program must be capable of plotting and diagramming time-current-characteristic curves as part of their output. Computer software program must report device settings and ratings of overcurrent protective devices and must demonstrate selective coordination by computer-generated, time-current coordination plots.
1. Optional Features:
    a. Arcing faults.
    b. Simultaneous faults.
    c. Explicit negative sequence.
    d. Mutual coupling in zero sequence.

E. Computer program must be designed to perform coordination studies or have function, component, or add-on module designed to perform coordination studies.

F. Computer program must be developed under supervision of licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

2.2 COORDINATION STUDY REPORT CONTENTS

A. Executive summary of study findings.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.

C. One-line diagram of modeled power system, showing the following:
1. Protective device designations and ampere ratings.
2. Conductor types, sizes, and lengths.
3. Transformer kVA and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, and panelboard designations.
6. Revisions to electrical equipment required by study.
7. Study Input Data: As described in "Power System Data" Article.
    a. Short-Circuit Study Output: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."

D. Protective Device Coordination Study:
1. Report recommended settings of protective devices, ready to be applied in field. Use manufacturer's data sheets for recording 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, and 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.

E. 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. Prepare separate sets of curves for switching schemes and for emergency periods where power source is local generation. Show the following information:
1. Device tag and title, one-line diagram with legend identifying portion of system covered.
2. Terminate device characteristic curves at point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.

3. Identify 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. Medium-voltage equipment overcurrent relays.
    b. Medium- and 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, and ANSI through-fault protection curves.
    e. Cables and conductors damage curves.
    f. Ground-fault protective devices.
    g. Motor-starting characteristics and motor damage points.
    h. Generator short-circuit decrement curve and generator damage point.
    i. Largest feeder circuit breaker in each motor-control center and panelboard.
5. Maintain selectivity for tripping currents caused by overloads.
6. Maintain maximum achievable selectivity for tripping currents caused by overloads on series-rated devices.
7. Provide adequate time margins between device characteristics such that selective operation is achieved.
8. 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 of the Work. 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 POWER SYSTEM DATA

A. Obtain data necessary for conduct of overcurrent protective device study.
    1. Verify completeness of data supplied in one-line diagram on Drawings. Call discrepancies to Architect's attention.
    2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.
    3. For equipment that is existing to remain, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. Qualifications of technicians and engineers must be in accordance with NFPA 70E.

B. Gather and tabulate required input data to support coordination study. List below is guide. Comply with recommendations in IEEE 551 for amount of detail required to be

acquired in field. Field data gathering must be by, or under supervision of, qualified electrical professional engineer. Data include, but are not limited to, the following:

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 impedance at 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 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 reactors, provide manufacturer and model designation, voltage rating, and impedance.
9. 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.
10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
12. Maximum demands from service meters.
13. Busway manufacturer and model designation, current rating, impedance, lengths, size, and conductor material.
14. Motor horsepower and NEMA MG 1 code letter designation.
15. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
16. Medium-voltage cable sizes, lengths, conductor material, cable construction, metallic shield performance parameters, and conduit material (magnetic or nonmagnetic).
17. Data sheets to supplement electrical distribution system one-line 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. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
    c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
    d. Generator thermal-damage curve.
    e. Time-current-characteristic curves of devices indicated to be coordinated.
    f. Manufacturer, frame size, interrupting rating in amperes root mean square (rms) symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
    g. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
    h. Switchgear, switchboards, motor-control centers, and panelboards ampacity, and SCCR in amperes rms symmetrical.

i. Identify series-rated interrupting devices for condition where available fault current is greater than interrupting rating of downstream equipment. Obtain device data details to allow verification that series application of these devices complies with NFPA 70 and UL 489 requirements.

3.3 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. Base study on device characteristics supplied by device manufacturer.

D. Extent of electrical power system to be studied is indicated on Drawings.

E. Begin analysis at service, extending down to system overcurrent protective devices as follows:
1. To normal system low-voltage load buses where fault current is 5 kA or less.
2. Exclude equipment supplied by single transformer smaller than 75 kVA.

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F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. Transformer Primary Overcurrent Protective Devices:
1. Device must not operate in response to the following:
a. Inrush current when first energized.
b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
2. Device settings must protect transformers according to IEEE C57.12.00, for fault currents.

H. Motor Protection:
1. Select protection for low-voltage motors according to IEEE 242 and NFPA 70.
2. Select protection for motors served at voltages more than 600 V according to IEEE 620.

I. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. Demonstrate that equipment withstands maximum short-circuit current for time equivalent to tripping time of primary relay protection or total clearing time of fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

J. Generator Protection: Select protection according to manufacturer's instructions and to IEEE 242.

K. Include ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase ac systems. Also account for fault-current dc decrement, to address asymmetrical requirements of interrupting equipment.

L. Calculate short-circuit momentary and interrupting duties for three-phase bolted fault and single line-to-ground fault at each equipment indicated on one-line diagram.
1. For grounded systems, provide bolted line-to-ground fault-current study for areas as defined for three-phase bolted fault short-circuit study.

M. 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. Application of series-rated devices must be recertified, complying with requirements in NFPA 70.
4. Include in report identification of protective device applied outside its capacity.

3.4 LOAD-FLOW AND VOLTAGE-DROP STUDY

A. Perform load-flow and voltage-drop study to determine steady-state loading profile of system. Analyze power system performance two times as follows:
1. Determine load flow and voltage drop based on full-load currents obtained in "Power System Data" Article.
2. Determine load flow and voltage drop based on 80 percent of design capacity of load buses.
3. Prepare load-flow and voltage-drop analysis and report to show power system components that are overloaded, or might become overloaded; show bus voltages that are less than as prescribed by NFPA 70.

3.5 MOTOR-STARTING STUDY

A. Perform motor-starting study to analyze transient effect of system's voltage profile during motor starting. Calculate significant motor-starting voltage profiles and analyze effects of motor starting on power system stability.

B. Prepare motor-starting study report, noting light flicker for limits proposed by IEEE 141, , and voltage sags so as not to affect operation of other utilization equipment on system supplying motor.

3.6 FIELD ADJUSTING

A. Adjust relay and protective device settings according to recommended settings provided by coordination study. Field adjustments must be completed by engineering service division of equipment manufacturer under "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 must be by qualified medium-voltage and low-voltage electrical testing and inspecting agency.
   1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters. Perform NETA tests and inspections for adjustable overcurrent protective devices.

END OF SECTION

SECTION 260573.19 – ARC-FLASH HAZARD ANALYSIS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Computer-based, arc-flash study to determine arc-flash hazard distance and incident energy to which personnel could be exposed during work on or near electrical equipment.

B. Related Requirements:
1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260573.13 "Short-Circuit Studies" for fault-current studies.
3. Section 260573.16 "Coordination Studies" for overcurrent protective device coordination studies.

1.2 ACTION SUBMITTALS

A. Product Data:
1. For power system analysis software to be used for studies.

B. Study Submittals:
1. Submit the following after approval of system protective devices submittals. Submittals may be in digital form:
a. Arc-flash study input data, including completed computer program input data sheets.
b. Submit study report for action prior to receiving final approval of 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 selection of devices and associated characteristics is satisfactory.
c. Revised one-line diagram, reflecting field investigation results and results of arc-flash study.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.4 QUALITY ASSURANCE

A. Study must be performed using commercially developed and distributed software designed specifically for power system analysis.

B. Software algorithms must comply with requirements of standards and guides specified in this Section.

C. Manual calculations are unacceptable.

1.5 REGULATORY AGENCY APPROVALS

A. Submittals for arc-flash hazard analysis requiring approval by authorities having jurisdiction must be signed and sealed by qualified electrical professional engineer responsible for their preparation.

B. Submittals for arc-flash hazard analysis require action by Architect prior to submitting for approval by authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE

A. Subject to compliance with additional requirements, provide power systems study using:
1. PowerTools for Windows (PTW32)
2. Etap Power System Analysis
3. Approved equal.

B. Comply with IEEE 1584 and NFPA 70E.

C. Analytical features of device coordination study computer software program must have capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

D. Computer program must be designed to perform arc-flash analysis or have function, component, or add-on module designed to perform arc-flash analysis.

E. Computer program must be developed under supervision of licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

2.2 ARC-FLASH STUDY REPORT CONTENT

A. Executive summary of study findings.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.

C. One-line diagram, showing the following:
1. Protective device designations and ampere ratings.
2. Conductor types, sizes, and lengths.

3. Transformer kVA and voltage ratings, including derating factors and environmental conditions.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, panelboard designations, and ratings.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output Data: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."

F. Protective Device Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in Section 260573.16 "Coordination Studies."

G. Arc-Flash Study Output Reports:
1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each equipment location included in report:
   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 symmetrical basis.
   g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on 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. Restricted approach boundary.
6. Limited approach boundary.
7. Working distance.
8. Incident energy.
9. Hazard risk category.
10. Recommendations for arc-flash energy reduction.

I. Fault study input data, case descriptions, and fault-current calculations including definition of terms and guide for interpretation of computer printout.

2.3 ARC-FLASH WARNING LABELS

A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for self-adhesive equipment labels. Produce 3.5 by 5 inch (76 by 127 mm) self-adhesive equipment label for each work location included in analysis.

B. Label must have orange header with wording, "WARNING, ARC-FLASH HAZARD," and must include the following information taken directly from arc-flash hazard analysis:

1. Location designation.
2. Nominal voltage.
3. Protection boundaries.
   a. Arc-flash boundary.
   b. Restricted approach boundary.
   c. Limited approach boundary.
4. Arc flash PPE category.
5. Required minimum arc rating of PPE in Cal/cm squared.
6. Available incident energy.
7. Working distance.
8. Engineering report number, revision number, and issue date.

C. Labels must be machine printed, with no field-applied markings.

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: Perform Short-Circuit and Protective Device Coordination studies prior to starting Arc-Flash Hazard Analysis.
   1. Short-Circuit Study Output: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."
   2. Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in Section 260573.16 "Coordination Studies."

C. Calculate maximum and minimum contributions of fault-current size.
   1. Maximum calculation must assume maximum contribution from campus electrical distribution system and must assume motors to be operating under full-load conditions.
   2. Calculate arc-flash energy at 85 percent of maximum short-circuit current in accordance with IEEE 1584 recommendations.
   3. Calculate arc-flash energy at 38 percent of maximum short-circuit current in accordance with NFPA 70E recommendations.
   4. Calculate arc-flash energy with campus electrical distribution system's contribution at minimum and assume no motor contribution.

D. Calculate arc-flash protection boundary and incident energy at locations in electrical distribution system where personnel could perform work on energized parts.

E. Include medium- and low-voltage equipment locations, except equipment fed from transformers smaller than 75 kVA.

F. Calculate limited, restricted, and prohibited approach boundaries for each location.

G. Incident energy calculations must consider accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations must take into account changing current contributions, as sources are interrupted or decremented with time. Fault contribution from motors and generators must be decremented as follows:
   1. Fault contribution from induction motors must not be considered beyond three to five cycles.
   2. Fault contribution from synchronous motors and generators must be decayed to match actual decrement of each as closely as possible (for example, contributions from permanent magnet generators will typically decay from 10 p.u. to 3 p.u. after 10 cycles).

H. Arc-flash energy must generally be reported for maximum of line or load side of circuit breaker. However, arc-flash computation must be performed and reported for both line and load side of circuit breaker as follows:
   1. When circuit breaker is in separate enclosure.
   2. When line terminals of circuit breaker are separate from 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 data necessary for conduct of arc-flash hazard analysis.
   1. Verify completeness of data supplied on one-line diagram on Drawings. Call discrepancies to Architect's attention.
   2. For new equipment, use characteristics from approved submittals under provisions of action submittals and information submittals for this Project.
   3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys conducted by qualified technicians and engineers.

B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to amount of detail that is required to be acquired in field. Field data gathering must be under direct supervision and control of engineer in charge of performing study, and must be by, or under supervision of, qualified electrical professional engineer. Data include, but are not limited to, the following:
   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 impedance or available short circuit current at 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 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 reactors, provide manufacturer and model designation, voltage rating and impedance.
9. 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.
10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
12. Busway manufacturer and model designation, current rating, impedance, lengths, size, and conductor material.
13. Motor horsepower and NEMA MG 1 code letter designation.
14. Low-voltage conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
15. Medium-voltage conductor sizes, lengths, conductor material, conductor construction and metallic shield performance parameters, and conduit material (magnetic or nonmagnetic).

3.4 LABELING

A. Applyarc-flash label on front cover of each section of equipment for each equipment included in study. Base arc-flash label data on highest values calculated at each location.

B. Each piece of equipment listed below must have arc-flash label applied to it:
   1. Medium-voltage switchgear.
   2. Medium-voltage switches.
   3. Medium voltage transformers.
   4. Low-voltage switchgear.
   5. Switchboards.
   6. Panelboards.
   7. Motor-control centers.
   8. Low voltage transformers.
   9. Safety switches.
   10. Control panels.

C. Note on record Drawings location of equipment where personnel could be exposed to arc-flash hazard during their work.
   1. Indicate arc-flash energy.
   2. Indicate protection level required.

3.5 APPLICATION OF WARNING LABELS

A. Install arc-flash warning labels under direct supervision and control of qualified electrical professional engineer.

END OF SECTION

SECTION 260943.16 – NETWORK LIGHTING CONTROLS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Digital Network Lighting Control System:
   1. System Software Interfaces
   2. System Backbone and Integration Equipment
   3. Wired Network Devices

1.2 DEFINITIONS

A. Data Bus: A wired interface used to communicate with connected devices.

B. Device: A collective term for bus or wireless connected devices, including fluorescent ballasts, LED drivers, incandescent luminaires, manual switches, switching relays, sensors, and similar.

C. Global: Communication between devices in otherwise separate spaces using a bridging device or system controller.

D. Group: A set of devices that communicate together.

E. 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.

F. Scene: Digital light level associated with a preset.

G. System Backbone: Devices used to connect and manage otherwise separate spaces, including bridging devices and gateways or system controllers. Used to expose devices to software configuration via TCP/IP.

1.3 DESIGN / PERFORMANCE REQUIREMENTS

A. Digital Network Lighting Control System shall accommodate the square-footage coverage requirements for each area controlled, utilizing room controllers, digital occupancy sensors, switches, dimmers, daylighting sensors and accessories that suit the required lighting and electrical system parameters.

B. System shall conform to requirements of NFPA 70.

C. System shall comply with FCC emission standards specified in part 15, sub-part J for commercial and residential application.

D. System shall be listed under UL sections 916 and/or 508.

1.4 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Catalog cut sheets and specifications.
   2. Ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
   3. Storage and handling requirements and recommendations.
   4. Installation instructions.
   5. Network Lighting Controls Certification
   6. Information Technology connection information pertaining to the interconnection with third party systems.

B. Shop Drawings:
   1. System Bill of Materials illustrating all equipment required for a full installation.
   2. Show location of devices, including at minimum load controllers, sensors, and switches/dimmers on reflected ceiling plans. Identify controlled circuits.
   3. Provide room/area typical wiring and/or installation details including products and sequence of operation for each room or area. Illustrate recommended room/area connection topologies.
   4. Network riser single line diagram including floor and building level details. Include network cable specification. Illustrate connections to any integrated systems. Coordinate integration with mechanical and/or other trades.

C. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

D. Closeout Submittals:
   1. Project Record Documents: Record actual installed locations and settings for lighting control devices.
   2. Operation and Maintenance Manual:
      a. Include approved Shop Drawings and Product Data.
      b. Include Sequence of Operation, with operation for each room or space.
      c. Include manufacturer's maintenance information.
      d. Operation and Maintenance Data: Include detailed information on device programming and setup.
      e. Include startup and test reports.

E. Title 24 Acceptance Testing Documentation: Submit Certification of Acceptance and associated documentation for lighting control acceptance testing performed in accordance with CALIFORNIA TITLE 24, PART 6, as specified in Part 3 of this specification under "COMMISSIONING".

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing of centralized and distributed lighting control systems with a minimum of 10 years documented experience.

B. Installer Qualifications: Company certified by the manufacturer and specializing in installation of networked lighting control products with minimum three years documented experience.

C. System Components: Demonstrate that individual components have undergone quality control and testing prior to shipping.

D. Certify and demonstrate that any controls provided that can connect to the internet provide a reasonable level of security and ensure that that devices that allow for communication between the controls system hierarchy or the internet are certified by ioXt Alliance and listed on the ioXt website's current Certified Product Page.

E. Remote Support: Manufacturer shall be capable of providing remote support and ability to virtually connect with customers to address issues with visual guidance overlaid on plan documentation.

F. Service Contracts: Manufacturer capable of providing service contracts for continued on-site remote support of the lighting control system post-installation for terms up to 10 years from substantial completion.

1.6 PRE-INSTALLATION MEETINGS

A. Convene minimum two weeks prior to commencing installation. Meeting to be attended by Contractor, Architect, system installer, commissioning authority, factory authorized manufacturer's representative, and representative of all trades related to the system installation.

B. Review installation procedures and coordination required with related Work and the following:
   1. Confirm the location and mounting of all devices, with special attention to placement of switches, dimmers, and any sensors.
   2. Review the specifications for low voltage control wiring and termination.
   3. Discuss the functionality and configuration of all products, including sequences of operation, per design requirements.
   4. Discuss differences between any wired or wireless products on the project.
   5. Discuss requirements for integration with other trades

C. Inspect and make notes of job conditions prior to installation:
   1. Record minutes of the conference and provide copies to all parties present.
   2. Identify all outstanding issues in writing designating the responsible party for follow-up action and the timetable for completion.
   3. Installation shall not begin until all outstanding issues are resolved to the satisfaction of the Architect.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation

1.8 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's documented limits.

B. Do not install equipment until following conditions can be maintained in spaces to receive equipment:
   1. Ambient temperature: 32 to 104 degrees F (0 to 40 degrees C).
   2. Relative humidity: Maximum 90 percent, non-condensing.

1.9 MAINTENANCE AND OPERATIONAL SERVICES

A. Phone Support: Toll-free technical support available from manufacturer through an online tool to schedule a technical support appointment and provide 24/7 emergency support.

B. Remote Support: Manufacturer capable of providing remote support and ability to virtually connect with customers to address issues with visual guidance overlaid on images of real-world objects.

C. Cellular Connectivity: Manufacturer capable of cellular connectivity to a networked lighting control systems available to provide remote support within the continental United States.

1.10 WARRANTY

A. Product Warranty: Manufacturer shall provide a 5 year warranty on products within this installation, except where otherwise noted, and consisting of a one for one device replacement of any devices deemed faulty. Manufacturer shall agree to repair or replace, including labor, materials and equipment, devices that fail to perform as specified within the warranty period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Wattstopper (DLM)
   2. nLite
   3. Cooper / Greengate (Wavelinx)
   4. Lutron (Vive)

B. Substitutions: As approved by the EOR

2.2 DIGITAL NETWORK LIGHTING CONTROL SYSTEM

A. System Architecture:
   1. Based upon the following concepts:
      a. Networkable intelligent lighting control devices.
      b. Standalone lighting control zones using distributed intelligence.
      c. Optional system backbone for remote, time-based, and global operation.
   2. Intelligent lighting control devices with individually addressable network communication capability and having one or more basic lighting control components including: occupancy sensor, photosensor, relay, dimming output, contact closure input, analog 0-10 V(dc) input, and manual wall station capable of indicating switching, dimming, and/or scene control. Combining one or more of these components into a single device enclosure permissible to minimize overall system device count.
   3. System capable of interfacing directly with networked luminaires such that either low-voltage network cabling or wireless RF communication is used to interconnect networked luminaires with control components such as sensors, switches, and system backbone.
   4. Networked luminaires and intelligent lighting control devices support individual (unique) configuration of device settings and properties, with such configuration residing within the networked luminaires and intelligent control devices.
   5. Lighting control zones consisting of one or more networked luminaires and intelligent lighting control devices capable of providing automatic control from sensors (occupancy and/or photosensor) and manual control from local wall stations without requiring connection to a higher-level system backbone.
      a. Lighting control zones (wired and wireless) support at least 128 devices per zone.
      b. Capable of being networked with a higher-level system backbone to provide time-based control, control from inputs or systems external to control zone, and remote configuration and monitoring through a software interface.
   6. Networked luminaires and intelligent lighting control devices with distributed intelligence programming stored in non-volatile memory, such that following any loss of power the lighting control zones operate according to their defined default settings and sequence of operations.
   7. System to include one or more system controllers that provide time-based control.
   8. System controller provides means of connecting the lighting control system to a system software interface and building management systems via BACnet/IP or BACnet MS/TP protocol.
   9. System controller supports both low-voltage wired and wireless RF communication within a single controller device.
   10. System devices support firmware update, either remotely or from within the application space, for purposes of upgrading functionality at a later date.
   11. System capable of reporting lighting system events and performance data to management software for display and analysis.

B. Wired Networked Control Zone Characteristics:
   1. Connections to devices within a wired networked lighting control zone and to backbone components accomplished with a single type of low-voltage network cable, compliant with CAT5e specifications or higher. Use of mixed types of low-voltage network cables is unacceptable.
   2. Devices connected in "daisy-chain" topology. "Hub-and-spoke" topology, requiring all individual networked devices to be connected to a central

component, is unacceptable, to reduce the total amount of network cable required for each control zone.

3. Pre-terminated, plenum-rated, low-voltage network cabling supplied with hardware.
4. Following proper installation and provision of power, all networked devices connected with low-voltage network cable must automatically form a functional lighting control zone without requiring any type of programming, regardless of the programming mechanism (e.g., software application, handheld remote, pushbutton).
    a. The "out of box" default sequence of operation is intended to provide typical sequence of operation to minimize the system startup and programming requirements and to also have functional lighting control operation prior to system startup and programming.
5. Networked devices capable of detecting improper communication wiring and LED notification to alert installation/startup personnel.
6. Networked control devices suitable for control of egress or emergency light sources without additional, externally mounted UL 924 shunting or 0-10 V(dc) disconnect devices, to provide a compliant sequence of operation while reducing the overall installation and wiring costs of the system. Capable of supporting the following sequence of operation:
    a. Low-Voltage Power Sensing: Devices automatically provide 100 percent light level upon detection of loss of power sensed via low-voltage network cable connection where applicable.
    b. Line-Voltage Power Sensing: Devices listed as UL 924 emergency relays which automatically close load-control relay and provide 100 percent light output upon detection of loss of power sensed via line voltage connection to normal power.
7. Global Control Zones: Networked luminaires and intelligent lighting control devices located in different areas able to transmit and track information within at least 128 system-wide control zones to support required sequences of operation that may span multiple areas. Occupancy, photosensor inhibit, and switch commands available across multiple controllers.
8. Wired Networked Wall Station Scene-Control Capabilities:
    a. Preset Scenes that activate a specific combination of light levels across multiple local and global channels.
    b. Local Profile Support: Profile Scenes that modify the sequence of operation for devices in the area (group) in response to a button press to dynamically optimize occupant experience and lighting energy usage.
        1) Wall stations able to manually start and stop local profiles, or local profile capable of ending after a specific duration of time between five minutes and 12 hours.
            a) Configurable Parameters:
            b) Fixture light level.
            c) Occupancy time delay.
            d) Response to occupancy sensors (including enabling/disabling response).
            e) Response to daylight sensors (including enabling/disabling response).
            f) Enabling/disabling wall stations.
    c. Three-Way or Multi-Way Control: Multiple wall stations capable of controlling the same local and global control zones, to support "multi-way"

preset scene and profile scene control.

C. Wireless Networked Control Zone Characteristics:
   1. No wired connections between networked devices required for the purposes of system communications.
   2. Multiple wireless networking protocols supported:
      a. Standards-based, distributed star topology type of protocol for 900 MHz communication, to support lighting control applications and IoT applications.
      b. Bluetooth standard protocol for 2.4 GHz communication that supports direct connection to smartphone or tablet, to support device configuration, control applications, and IoT without requiring the use of a system backbone.
   3. Wireless network must be self-healing, such that the loss of backbone or local communication between devices does not result in the loss of local control of lights in the space.
   4. Wireless network communication must support uniform and instant response such that all luminaires in a lighting control zone respond immediately and synchronously in response to a sensor or wall station signal.
   5. Communication of control signals from sensors and wall stations to networked luminaires and wireless load-control devices occur directly, without any communication, interpretation, or translation of information through a backbone device such as a wireless access point, communication bridge, or gateway.
   6. All wireless communication between lighting control components supports the following five tiers of security measures.
      a. Data encryption.
      b. Firmware protection.
      c. Tamper-proof hardware.
      d. Authenticated user access.
      e. Mutual device authentication.
   7. Wireless devices use AES encryption to secure communication with a unique encryption key generated for each programmed site.
   8. Wireless devices use signed firmware to ensure that unmodified, authentic software is always installed.
   9. Wireless networked devices capable of communicating a minimum distance of 150 ft. (45 m) between devices under typical site conditions accounting for typical environmental conditions and building construction materials encountered within commercial indoor lighting environments.
   10. Minimum Line-of-Sight Communication Range: 1000 ft. (304 m) under ideal environmental conditions.
   11. Wireless devices self-identify when communication to system controller cannot be accomplished or when communication to the system controller is lost.
      a. Self-identification not required for wireless switches or battery-powered devices.
   12. Wireless devices self-establish connection to system controller through other devices if direct communication cannot be accomplished or when communication to system controller is lost.
      a. Communication path formation to utilize existing wireless networked devices located between system controller and respective end devices.
      b. No additional hardware for formation of networked communication path between a system controller and end devices required.

c. Automatic connection not required for wireless switches or battery-powered devices.

13. Networked control devices suitable for control of egress or emergency light sources without additional, externally mounted UL 924 shunting or 0-10 V(dc) disconnect devices, to provide a compliant sequence of operation while reducing the overall installation and wiring costs of the system. Capable of supporting the following sequence of operation:
    a. Line-Voltage Power Sensing: Devices listed as UL 924 emergency relays that automatically close load-control relay and provide 100 percent light output upon detection of loss of power sensed via line voltage connection to normal power.
    b. Normal-Power-Broadcast Sensing: Devices listed as UL 924 emergency relays that automatically close load-control relay and provide 100 percent light output upon loss of a wireless normal-power broadcast from devices connected to normal power.

D. System Integration Capabilities:
    1. Capable of interface with third-party building management systems (BMS) to support two-way communication using BACnet/IP protocol, BACnet MS/TP protocol, and RESTful API including the following system integration capabilities:
        a. "Write" messages for control of individual devices, including control of relay and dimming output.
        b. "Write" messages for control of groups of devices through a single command, including control of relay and dimming output of all devices.
        c. "Read" messages for individual device status information.
            1) Available status will vary based on device type and capabilities, which may include relay state, dimming output, power measurement, occupancy sensor status, and photosensor light measurement.
        d. "Read" messages for group status information for occupancy, relay state, and dimming output.
        e. Activation of pre-defined system Global Profiles.
    2. Activation of Global Profiles from third-party systems via dry contact closure output signals or digital commands via RS-232 or RS-485
    3. Activation of demand response levels from Demand Response Automation Servers (DRAS) via OpenADR 2.0a protocol

E. Systems software interfaces
    1. Management Interface:
        a. Web-based management interface for remote system control, live status monitoring, and configuration of lighting control settings and schedules.
        b. Compatible with industry-standard web browser clients.
        c. Minimum of three user permission levels: read-only, read and change settings, and full administrative system access.
        d. Capable of restricting access for user accounts to specific devices within the system.
        e. All system devices capable of being given user-defined names.
        f. Management interface capable of displaying live status of a networked luminaire or intelligent control device including:
            1) Luminaire on/off status.
            2) Dim level.
            3) Power consumption.

4) Device temperature.
5) PIR occupancy sensor status.
6) Remaining occupancy time delay.
7) Photosensor reading.
8) Active Profiles.

g. Management interface capable of displaying and modifying the current active settings of a networked luminaire or intelligent control device including:
1) Dimming trim levels.
2) Occupancy sensor and photosensor enable/disable.
3) Occupancy sensor time delay and light level settings.
4) Occupancy sensor response (normal or vacancy).
5) Photosensor setpoints and transition time delays.

h. Management interface capable of applying settings changes for a zone of devices or a group of selected devices using a single action that does not require the user to apply settings changes for each individual device.

i. Management interface capable of compiling a printable network inventory report.

j. Management interface capable of compiling a printable report detailing all system profiles.

k. All sensitive information stored encrypted.

l. System software updates available for automatic download and installation via the Internet.

2. System Energy Analysis and Reporting:
a. Intuitive graphical screens to facilitate simple viewing of system energy performance.
b. Software calculates allocation of energy savings by control measures including occupancy sensors, photosensors, and manual switching.
c. Energy savings data calculated for the system as a whole.
d. Time-scaled graph showing all relay transitions.
e. Time-scaled graph showing zone occupancy time delays.
f. Time-scaled graph showing the total light level.

3. Visualization and Programming Interfaces:
a. System provides an optional web-based visualization interface that displays a graphical floorplan.
b. Graphical floorplan will offer the following types of system visualization:
1) Full Device Option: Master graphic of entire building, by floor, showing each control device installed with zones outlined including:
a) Controls devices
b) Daylight sensors.
c) Occupancy sensors.
d) Wall switches and dimmers.
e) Scene controllers.
f) Networked relays.
g) System Controllers.
h) Wired relay panels.
i) Group outlines.

c. Programming capabilities through the application will include the following:
1) Switch, occupancy sensor, and photosensor zone configuration.
2) Manual-on or automatic-on modes.
3) Turn-on and dim to dimming levels.

4) Occupancy sensor time delays and PIR sensitivity.
5) Dual technology occupancy sensors sensitivity.
6) Photosensor calibration adjustment and auto-setpoint.
7) Multiple photosensor zone offset.
8) Trim level settings.
9) Preset scene creation and copy for scene-capable devices.
10) Application of custom device labels to the Bluetooth Low-Energy Programming Devices and individual connected lighting control devices.
11) Fade rate settings.

F. System backbone and system integration equipment
1. System Controller: Multi-tasking, real-time digital control processor consisting of modular hardware with plug-in enclosed processors, communication controllers, and power supplies.
a. System Controller Functions:
1) Time-based control of downstream wired and wireless network devices.
2) Linking into an Ethernet network.
3) Integration with Building Management Systems (BMS) and Heating, Ventilation and Air Conditioning (HVAC) equipment.
4) Connection to various software interfaces, including management interface, historical database and analytics interface, and visualization interface.
2. Integral web server to support system controller configuration and diagnostics.
a. Web Server Control Interface:
1) Display associated devices within the context of a graphical floorplan.
2) Provide control of output-capable devices through virtual sliders, toggle buttons, preset level widgets, and transparent layers on floorplan.
3) Control Capabilities:
4) Control of individual output devices, including control of relay state and analog dimming level where applicable.
5) Control of local lighting control zones, including control of relay state and analog dimming level where applicable.
6) Control of global lighting control zones, including control of relay state and analog dimming level where applicable.
3. Graphical touch screen to support configuration and diagnostics.
4. Minimum of three RJ-45 networked lighting control ports for connection to any of the following:
a. Graphical touch screen.
b. Wired communication bridges.
c. Direct connection to networked wired luminaires and intelligent lighting control devices (up to 128 total devices per port).
5. Device will automatically detect all network-connected devices.
6. Supports BACnet/IP and BACnet MS/TP protocols to directly interface with BMS and HVAC equipment without additional protocol translation gateways.
7. Supports RESTful API for control of BACnet objects, user management, date and time, and file management.
8. NEMA 1 enclosure with Class 1 and Class 2 separation.

a. Power Supply Voltage: 120 to 277

9. Automatic algorithm to eliminate redundant, wireless networked paths to streamline communication between the system controller and end devices.
10. System Controller Security Provisions:
    a. Support user role-based access, such as administrator, user, and viewer.
    b. Signed firmware to ensure that unmodified, authentic software is always installed.
    c. IP-based communication protected with strong encryption algorithms such as AES or TLS1.2+.
    d. Prevent rollback of firmware to firmware versions with known, critical vulnerabilities.
    e. Valid cybersecurity listing through a third party.
11. Cellular Remote Access: Cellular router and modem for remote access.
    a. Remote access capable of device setting updates, schedule updates, system performance optimization, and diagnostics.
    b. Remote access enabled through outbound communication from router to an outside source. Solutions that begin communication via inbound requests for network access are unacceptable.
    c. Router supports outbound communication to manufacturer-hosted portal using TLS1.2 or greater in-transit encryption over a cellular or Ethernet connection.
    d. Router with integral firewall to prevent unauthorized access to devices connected to its local area network port.
    e. Router includes cellular SIM capable of connection to AT&T, T-Mobile, Sprint, US Cellular, Alaska Wireless, Telefonica, Tellus, Bell, or Sasktel networks where carrier service is available.
    f. Outbound communication from the router limited to whitelisted endpoints. Devices that allow unrestricted communication are unacceptable.
    g. Outbound communication from router includes only lighting control system information.

2.3 WIRED NETWORKED DEVICES

A. Wired Networked Wall Switches, Dimmers, Scene Controllers:
1. Communication and low-voltage power delivered via standard low-voltage network cabling with RJ-45 connectors.
2. Devices with mechanical push buttons provide tactile and LED user feedback.
3. Devices with mechanical push buttons manufactured with custom button labeling.
4. Wall switch and dimmer options:
    a. Number of control zones: as per plan documentation
    b. Control Types Supported:
        1) On/Off.
        2) On/Off/Dimming.
        3) On/Off/Dimming/Correlated Color Temperature Control for specific luminaire types.
    c. Color: as per architectural requirements
5. Scene Controller Options:
    a. Number of Scenes: as per plan documentation
    b. Control Types Supported:

1) On/Off.
2) On/Off/Dimming.
3) Preset Level Scene Type.
4) On/Off/Dimming/Preset Level for Correlated Color Temperature.

c. Color: as per architectural requirements

B. Networked Graphic Wall Stations:
1. Mounting: Suitable for installation in single-gang switch box.
2. Communication over standard low-voltage network cabling with RJ-45 connectors.
3. User-customizable screen saver utilizing uploaded image file in common file format including jpg, png, gif, bmp, or tif.
4. Capable of configuration of all switches, dimmers, control zones, and lighting preset scenes via password-protected setup screens.
5. Graphic Wall Station Options:
a. Number of Control Zones: Up to 16.
b. Number of Scenes: Up to 16.
c. Profile Scene Duration: User configurable from five minutes to 12 hours.
d. Color: as per architectural requirements

C. Digital Time Clock:
1. Capable of up to 32 schedules. Each schedule consists of one set of On and Off times per day for each day of the week and for each of two holiday lists. Schedules assignable to any individual relay or group of relays.
2. Operates from non-volatile memory so that all system programming is retained indefinitely.
3. Mounted inside a relay panel to eliminate the necessity for additional enclosures for complete installation.
4. Capacitive full-color touch screen.

D. Wired Networked Digital Key Switches:
1. Mounting: Suitable for installation in single-gang switch box.
2. Communication and low-voltage power delivered via standard low-voltage network cabling with RJ-45 connectors.
3. All switches detect valid communication and blink a unique LED pattern to visually indicate a potential wiring issue.
4. LED user feedback to provide indication of on/off status of the programmed lights or scene, as well as indication of device power.
5. Digital Key Switch Options:
a. Control Types Supported:
1) On/Off.
2) On/Off/Dimming.
3) Preset Level Scene Type.
4) On/Off/Dimming/Preset Level for Correlated Color Temperature.
5) User-programmed local lighting scene run within a daisy-chained group including manual start/stop from the switch, or optionally programmed automatic-stop after a user-selectable duration between five minutes and 12 hours.
6) User-programmed global lighting profile run by an upstream controller across multiple groups including manual start/stop from the switch, or optionally programmed automatic-stop after a user-selectable

duration between five minutes and 12 hours.

b. Color: as per architectural requirements

E. Wired Networked Auxiliary Input / Output (I/O) Devices:
1. Plenum rated.
2. Communication and low-voltage power delivered to each device via standard low-voltage network cabling with RJ-45 connectors.
3. Auxiliary Input/Output Devices Options:
   a. Contact closure or pull-high input.
      1) Input programmable to support maintained or momentary inputs that can activate local or global scenes and profiles, activate lights at a preconfigured level, ramp light level up or down, or toggle lights on/off.
   b. 0-10V analog input.
      1) Input supports zero to 10 V dimming output control from a dimmer switch.
      2) Input programmable to function as a daylight sensor.
   c. RS-232/RS-485 digital input.
      1) Input supports activation of up to four local or global scenes and profiles, and on/off/dimming control of up to 16 local control zones.
      2) Provides relay and dimming level status to external device (e.g., Touchscreen) when polled.
   d. 0-10V dimming control output, capable of sinking up to 20mA.
      1) Output programmable to support all standard sequence of operations supported by system.
   e. Digital control output via eldoLED LEDcode communication.
      1) Output programmable to support light intensity control, as well as optional correlated color temperature (CCT) control, of the connected luminaire.

F. Wired Networked Occupancy and Photosensors:
1. Detect the presence of human activity within space and fully control the on/off function of lights.
2. Utilize passive infrared (PIR) technology, which detects occupant motion, to initially turn lights on from an off state, thus preventing false on conditions.
3. Dual technology sensors used in locations where a second method of sensing is necessary to adequately detect maintained occupancy (such as in rooms with obstructions).
4. Dual technology sensors must have one sensing technology not motion dependent to detect occupancy.
5. Ceiling, fixture, recessed, and corner mounted sensors available, with multiple lens options available customized for specific applications.
6. Communication and low-voltage power delivered to each device via standard low-voltage network cabling with RJ-45 connectors.
7. All sensors detect valid communication and blink a unique LED pattern to visually indicate a potential wiring issue.
8. Sensor programming parameter available and configurable remotely from the software and locally via the device push button.
9. Ceiling mount occupancy sensors include one integrated dry contact switching relay, capable of switching 1 A at 24 V, resistive only.
10. Sensors available with one or two occupancy "poles," each of which provides a

programmable time delay.

11. Photosensor/daylight override, automatic dimming control, and low temperature/high humidity operation.
12. Photosensor provide one on/off set-point and include a dead band to prevent the artificial light from cycling. Delay incorporated into the photosensor to prevent rapid response to passing clouds.
13. Photosensor and dimming sensor's set-point and dead band automatically calibrated through the sensor's microprocessor by initiating an "Automatic Set-Point Programming" procedure. Min and max dim settings as well as set-point may be manually entered or modified.
14. Dead band setting verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space (i.e., furniture layouts, lamp depreciation, or lamp outages).
15. Dual zone option available for On/Off Photosensor, Automatic Dimming Control Photosensor, or Combination units. The secondary daylight zone capable of being controlled as an "offset" from the primary zone.

G. Wired Networked Wall Switch Sensors:
   1. Communication and low-voltage power delivered via standard low-voltage network cabling with RJ-45 connectors.
   2. All switches detect valid communication and blink a unique LED pattern to visually indicate a potential wiring issue.
   3. Devices with mechanical push buttons provide tactile and LED user feedback.
   4. Wall Switch Sensor Options:
      a. User Input Control Types: On/Off/Dimming.
      b. Occupancy Sensing Technology: Dual technology
      c. Daylight Sensing Option: Inhibit Photosensor.
      d. Color: as per architectural requirements

H. Wired Networked Embedded Fixture Sensors:
   1. Network system sensors with occupancy sensors and/or dimming photosensors that can be embedded into luminaire such that only the lens shows on luminaire face.
   2. Occupancy sensor detection pattern suitable for 7.5 to 20-ft. mounting heights.
   3. Embedded Sensor Options:
      a. Occupancy Sensing technology: Dual technology.
      b. Sensing Option: Combination Occupancy/Daylight sensor.

I. Wired Networked Power Packs:
   1. Plenum rated.
   2. Communication will be delivered to each device via standard low-voltage network cabling with RJ-45 connectors.
   3. Supply Voltage: 120 to 277
   4. Relay Output: Class 1 relay rated for 16 A at 277V(ac) and 1/2 HP at 120 V(ac).
   5. Dimming Output: 0-10 VDC Dimming output.

PART 3 - EXECUTION

3.1 PREPARATION

A. Do not begin installation until measurements have been verified and work areas have been properly prepared.

B. If preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Verify that required pre-installation meeting specified in Part 1 of this specification has been completed, recorded meeting minutes have been distributed and all outstanding issues noted have been resolved prior to the start of installation.

3.2 INSTALLATION

A. Install system in accordance with the approved system shop drawings and manufacturer's instructions.

B. Install all room/area devices using manufacturer's factory-tested Cat 5e cable with pre-terminated RJ-45 connectors.
   1. If pre-terminated cable is not used for room/area wiring, each field-terminated cable shall be tested following installation and testing results submitted to the Manufacturer's Representative for approval prior to proceeding with the Work.
   2. Install all Wired room-to-room network devices using manufacturer-sourced network wire or wireless devices. Network wire substitution is not permitted and may result in loss of product warranty.
   3. Low voltage wiring topology for each type of connector must comply with manufacturer's specifications.
   4. Route network wiring as indicated on the Drawings as closely as possible. Document final wiring location, routing, and topology in as built drawings.

C. All line voltage connections shall be tagged to indicate circuit and switchleg designations. Junction box covers should also provide circuit and switchleg info.

D. Identify all controls with device address.

E. Test all devices to ensure they are powered and communicate properly with each other.

F. Following manufacturer's recommendations, calibrate all sensor sensitivities and adjust mounting/locations to ensure proper detection of occupants and energy savings. Adjust time delay so that controlled area remains lighted while occupied.

G. Provide written or computer-generated documentation on the configuration of the system including room by room description including:
   1. Sequence of Operation, (e.g., Auto On, Partial ON, Partial Off, etc.)
   2. Load parameters (e.g., blink warning, group integrations, etc.)
   3. Sensor parameters, time delays, sensitivities, and daylighting setpoints.

H. Post start-up tuning - Adjust sensor time delays and sensitivities to meet the Owner's requirements 30 days from beneficial occupancy. Provide a detailed report to the Architect / Owner of post start-up activity.

I. Tighten Class 1 conductors at circuit breaker and termination point to torque ratings marked on enclosure or device's UL label or installation instructions.

J. Class 2 cabling shall enter enclosures from within low-voltage wiring areas and shall remain within those areas. No Class 1 conductors shall enter a low-voltage area.

K. Run separate neutrals for any phase dimmed branch load circuit. Different types of dimming loads require separate neutrals and should not be mixed within any individual room controller.

L. Verify all lighting loads to be free from short circuits prior to connection to room controllers or relays inside panels.

M. Lighting Control installer to take steps needed to co-ordinate with the installer of the same manufacturer's Shade products to ensure both systems will be integrated into the room's local Cat 5e In Room Bus or Wireless communication network. Contractor to verify whether local Shade override devices should be mounted with those for the Lighting Control system. Each installer shall verify that their hardware has been set up properly for independent operation, and that once connected, still operates properly. Lighting Control installer should verify if a single network communication bridge is to be installed in the room so both systems be connected to other rooms and a single set of front end devices.

3.3 SYSTEM STARTUP AND FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Notify Architect and Manufacturer in writing a minimum of 3 weeks prior to system start-up and testing.

B. Tests and Inspections: Manufacturer's service representative shall perform the following inspections and prepare reports.
   1. Verify Class 1 and 2 wiring connections are terminated properly by validating system performance.
   2. Set IP addresses and other network settings of system front end hardware per facilities IT instructions.
   3. Verify / complete task programming for all switches, dimmers, time clocks, occupancy sensors, daylighting controls, and input/output modules.
   4. Verify the control of each space complies with the Sequence of Operation.
   5. Correct any system issues and retest.

C. Provide a report in table format with drawings or using a software file that can be opened in the manufacturer's system software including each room or space that has lighting control installed. Include the following:
   1. Date of test or inspection.
   2. Loads per space, or Fixture or Wireless Device Address identification.
   3. Quantity and Type of each device installed
   4. Reports providing each device's settings.

D. Coordinate testing requirements with contracted Commissioning agent. Provide all

required information for prefuncational testing.

E. Provide on-site adjustments as needed for a period of 30 days after approved acceptance testing for warranty and adjustment of setpoints.

3.4 DEMONSTRATION AND TRAINING

A. Before Substantial Completion, arrange and provide a one-day Owner instruction period to designated Owner personnel. Set-up, starting of the lighting control system and Owner instruction includes:
   1. Confirmation of entire system operation and communication to each device.
   2. Confirmation of operation of individual relays, switches, and sensors.
   3. Confirmation of system Programming, photocell settings, override settings, etc.
   4. Provide training to cover installation, programming, operation, and troubleshooting of the lighting control system.

3.5 PRODUCT SUPPORT AND SERVICE

A. Factory telephone support shall be available at no cost to the Owner following acceptance. Factory assistance shall consist of assistance in solving application issues pertaining to the control equipment.

END OF SECTION

SECTION 261219 – PAD-MOUNTED, LIQUID-FILLED, MEDIUM-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Pad-mounted, liquid-filled, medium-voltage distribution transformers, with primary and secondary bushings within or without air-terminal enclosures.

B. Related Requirements:
   1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data:
   1. For each type of product.
      a. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Shop Drawings:
   1. For pad-mounted, liquid-filled, medium-voltage transformers.
      a. Include plans and elevations showing major components and features.
         1) Include plan view and cross section of equipment base, showing clearances, required workspace, and locations of penetrations for grounding and conduits.
      b. Include details of equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of field connections.
      c. Include single-line diagram.
      d. Include list of materials.
      e. Include nameplate data.
      f. Manufacturer's published time-current curves of transformer line-side fuses, with transformer damage curve, inrush curve, and thru fault current indicated.

C. Field Quality-Control Submittals:
   1. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

B. Comply with IEEE C2.

C. Comply with IEEE C57.12.00.

2.2 PERFORMANCE REQUIREMENTS

A. Windings Material: Copper.

B. Surge Arresters: Comply with IEEE C62.11, Distribution Class; metal-oxide-varistor type, fully shielded, separable-elbow type, suitable for plugging into inserts provided in line-side section of transformer. Connected in each phase of incoming circuit and ahead of disconnecting device.

C. Winding Connections: Connection of windings and terminal markings must comply with IEEE C57.12.70.

D. Efficiency: Comply with 10 CFR 431, Subpart K.

E. Insulation: Transformer kVA rating must be as follows: Average winding temperature rise above 30 deg C ambient temperature must not exceed 65 deg C and 80 deg C hottest-spot temperature rise at rated kVA when tested in accordance with IEEE C57.12.90, using combination of connections and taps that give highest average winding temperature rise.

F. Tap Changer: External handle, for de-energized operation.

G. Tank: Sealed, with welded-on cover. Designed to withstand internal pressure of not less than 7 psi (50 kPa) without permanent distortion and 15 psig (104 kPa) without rupture. Comply with IEEE C57.12.36.

H. Enclosure Integrity: Comply with IEEE C57.12.28 for pad-mounted enclosures that contain energized electrical equipment in excess of 600 V that may be exposed to public.

I. Mounting: Integral skid mounting frame, suitable to allow skidding or rolling of transformer in any direction, and with provision for anchoring frame to pad.

J. Insulating Liquids:
1. Mineral Oil.

K. Sound level must comply with NEMA TR 1 requirements.

L. Corrosion Protection:
1. Transformer coating system must be factory applied, complying with requirements of IEEE C57.12.29, in manufacturer's standard color green.

2.3 THREE-PHASE TRANSFORMERS

A. Description:
1. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Comply with IEEE C57.12.26.

B. Compartment Construction:
1. Double-Compartment Construction: Individual compartments for line- and load-side sections, formed by steel isolating barriers that extend full height and depth of compartments, with hinged, lift-off doors and three-point latching, with stop in open position and provision for padlocking.

C. Primary Fusing: Designed and rated to provide thermal protection of transformer by sensing overcurrent and high liquid temperature.
1. 95 kV BIL current-limiting fuses, conforming to requirements of IEEE C37.47.
2. Interrupting Rating: 50 000 A(rms sym) at system voltage.
3. Fuse Assembly: Bayonet-type, liquid-immersed, expulsion fuses in series with liquid-immersed, partial-range, current-limiting fuses. Bayonet fuse must sense both high currents and high oil temperature to provide thermal protection to transformer.
4. Provide bayonet fuse assembly with oil retention valve and external drip shield inside housing to eliminate or minimize oil spills. Valve must close when fuse holder is removed and external drip shield is installed.
5. Provide conspicuously displayed warning adjacent to bayonet fuse(s), cautioning against removing or inserting fuses unless transformer has been de-energized and tank pressure has been released.

D. Line-Side Section: Dead-front design.
1. To connect primary cable, use separable insulated connectors; coordinated with and complying with requirements of Section 260513 "Medium-Voltage Cables." Bushings must be one-piece units, with ampere and BIL ratings same as connectors.
2. Bushing wells configured for loop-feed application.
3. Access to liquid-immersed fuses.
4. Dead-front surge arresters.
5. Tap-changer operator.
6. Load-Break Switch:
a. Radial-feed, liquid-immersed type with voltage class and BIL matching that of separable connectors, with continuous current rating and load-break rating of 200 A, and make-and-latch rating of 12 kA(rms sym).
b. Loop-feed sectionalizing switches, using three two-position, liquid-immersed-type switches for closed transition loop-feed and sectionalizing operation. Voltage class and BIL must match that of separable connectors,

with continuous current rating and load-break rating of 200 A, and make-and-latch rating of 12 kA(rms sym). Switch operation must be as follows:
1) Position I: Line A connected to line B and both lines connected to transformer.
2) Position II: Transformer connected to line A only.
3) Position III: Transformer connected to line B only.
4) Position IV: Transformer disconnected and line A not connected to line B.
5) Position V: Transformer disconnected and line A connected to line B.

7. Ground pad.

E. Load-Side Section:
1. Bushings with spade terminals drilled for terminating number of conductors indicated on Drawings, and lugs that comply with requirements of Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

F. Capacities and Characteristics:
1. Power Rating: refer to drawings.
2. Voltage Ratings: refer to drawings.
3. Taps: Comply with IEEE C57.12.26 requirements.
4. Transformer BIL (kV): Comply with IEEE C57.12.26 requirements.
5. Minimum Tested Impedance (Percent) at 85 deg C: 5.75.

G. Transformer Accessories:
1. Drain and filter connection.
2. Filling and top filter press connections.
3. Pressure-vacuum gauge.
4. Dial-type analog thermometer with alarm contacts.
5. Magnetic liquid level indicator with high and low alarm contacts.
6. Automatically resetting pressure-relief device. Device flow must be as recommended by manufacturer.
7. Stainless steel ground connection pads.
8. Machine-engraved nameplate, made of anodized aluminum or stainless steel.
9. Sudden pressure relay for remote alarm or trip when internal transformer pressure rises at field-set rate. Provide with seal-in delay.

2.4 WARNING LABELS AND SIGNS

A. Comply with requirements for labels and signs specified in Section 260553 "Identification for Electrical Systems."
1. High-Voltage Warning Label: Provide self-adhesive warning signs on outside of line-side compartment door(s). Sign legend must be "DANGER HIGH VOLTAGE" printed in two lines of nominal 2 inch (50 mm) high letters. Word "DANGER" must be in white letters on red background and words "HIGH VOLTAGE" must be in black letters on white background.
2. Arc Flash Warning Label: Provide self-adhesive warning signs on outside of line-side compartment door(s), warning of potential electrical arc flash hazards and appropriate personal protective equipment required.

2.5 SOURCE QUALITY CONTROL

A. Owner will witness required factory tests. Notify Architect at least 14 days before date of tests and indicate their approximate duration.

B. Testing Administrant: Engage qualified electrical testing agency to evaluate transformer.

C. Testing: Test and inspect transformer in accordance with IEEE C57.12.90.

D. Factory Tests and Inspections: Perform the following tests and inspections, by, or under supervision of, qualified electrical testing laboratory recognized by authorities having jurisdiction, before delivering to site. Affix label with name and date of qualified electrical testing laboratory's certification of system compliance on control units.
   1. Resistance.
   2. Turns ratio, polarity, and phase relation.
   3. Transformer no-load losses and excitation current at 100 percent of ratings.
   4. Transformer impedance voltage and load loss.
   5. Operation of devices.
   6. Lightning impulse.
   7. Low frequency.
   8. Leak.
   9. Perform Optional Tests:
      a. Transformer no-load losses and excitation current at 110 percent of ratings.
      b. Insulation power factor.
      c. Applied potential, except that this test is not required for single-phase transformers or for three-phase Y-Y-connected transformers.
      d. Induced potential.
      e. Resistance measurements of windings on rated voltage connection and at tap extreme connections.
      f. Ratios on rated voltage connection and at tap extreme connections.
      g. Polarity and phase relation on rated voltage connection.
      h. No-load loss at rated voltage on rated voltage connection.
      i. Exciting current at rated voltage on rated voltage connection.
      j. Impedance.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine pad-mounted, liquid-filled, medium-voltage transformers upon delivery.
   1. Upon delivery of transformers and prior to unloading, inspect equipment for damage that may have occurred during shipment or storage.
   2. Verify that tie rods and chains are undamaged and tight, and that blocking and bracing is tight. Verify that there is no evidence of load shifting in transit, and that readings from transportation shock recorders, if equipped, are within manufacturer's recommendations.
   3. Verify that there is no indication of external damage and no dents or scratches in doors and sill, tank walls, radiators and fins, or termination provisions.

4. Verify that there is no evidence of insulating-liquid leakage on transformer surfaces, at weld seams, on line- or load-side bushing parts, and at transformer base.
5. Verify that there is positive pressure or vacuum on tank. Check pressure gauge: it is required to read other than zero.
6. Compare transformers and accessories received with bill of materials to verify that shipment is complete. Verify that transformers and accessories conform with manufacturer's quotation and shop drawings. If shipment is incomplete or does not comply with Project requirements, notify manufacturer in writing immediately.
7. Verify presence of polychlorinated biphenyl content labeling.
8. Unload transformers carefully, observing packing label warnings and handling instructions.
9. Open termination compartment doors and inspect components for damage or displaced parts, loose or broken connections, cracked or chipped insulators, bent mounting flanges, dirt or foreign material, and water or moisture.

B. Handling:
1. Handle transformers carefully, in accordance with manufacturer recommendations, to avoid damage to enclosure, termination compartments, base, frame, tank, and internal components. Do not subject transformers to impact, jolting, jarring, or rough handling.
2. Protect transformer termination compartments against entrance of dust, rain, and snow.
3. Transport transformers upright, to avoid internal stresses on core and coil mounting assembly and to prevent trapping air in windings. Do not tilt or tip transformers.
4. Verify that transformer weights are within rated capacity of handling equipment.
5. Use only manufacturer-recommended points for lifting, jacking, and pulling. Use lifting lugs when lifting transformers.
6. Use jacks only at corners of tank base plate.
7. Use nylon straps of same length to balance and distribute weight when handling transformers with crane.
8. Use spreaders or lifting beam to obtain vertical lift and to protect transformer from straps bearing against enclosure. Lifting cable pull angles may not be greater than 15 degrees from vertical.
9. Exercise care not to damage tank base structure when handling transformer using skids or rollers. Use skids to distribute stresses over tank base when using rollers under large transformers.

C. Storage:
1. Store transformers in accordance with manufacturer's recommendations.
2. Transformers may be stored outdoors. If possible, store transformers at final installation locations on concrete pads. If dry concrete surfaces are unavailable, use pallets of adequate strength to protect transformers from direct contact with ground. Ensure transformer is level.
3. Ensure that transformer storage location is clean and protected from severe conditions. Protect transformers from dirt, water, contamination, and physical damage. Do not store transformers in presence of corrosive or explosive gases. Protect transformers from weather when stored for more than three months.
4. Store transformers with compartment doors closed.

5. Regularly inspect transformers while in storage and maintain documentation of storage conditions, noting discrepancies or adverse conditions. Verify that effective pressure seal is maintained using pressure gauges. Visually check for insulating-liquid leaks and rust spots.

D. Examine areas and space conditions for compliance with requirements for pad-mounted, liquid-filled, medium-voltage transformers and other conditions affecting performance of the Work.

E. Examine roughing-in of conduits and grounding systems to verify the following:
1. Wiring entries comply with layout requirements.
2. Entries are within conduit-entry tolerances specified by manufacturer, and no feeders will cross section barriers to reach load or line lugs.

F. Examine concrete bases for suitable conditions for transformer installation.

G. Pre-Installation Checks:
1. Verify removal of shipping bracing after placement.
2. Remove sample of insulating liquid in accordance with ASTM D923. Insulating-liquid values must comply with NETA ATS, Table 100.4. Sample must be tested for the following:
a. Dielectric Breakdown Voltage: ASTM D877 or ASTM D1816.
b. Acid Neutralization Number: ASTM D974.
c. Specific Gravity: ASTM D1298.
d. Interfacial Tension: ASTM D971.
e. Color: ASTM D1500.
f. Visual Condition: ASTM D1524.
g. Water in Insulating Liquids: Comply with ASTM D1533.
h. Power Factor or Dissipation Factor: ASTM D924.

H. Verify that ground connections are in place and that requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance must be 5 Ω at transformer location.

I. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install transformers on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 260529 "Hangers and Supports for Electrical Systems."

B. Transformer must be installed level and plumb and must tilt less than 1.5 degrees while energized.

C. Comply with requirements for vibration isolation and seismic control devices specified in Section 260529 "Hangers and Supports for Electrical Systems" and Section 260548 "Vibration and Seismic Controls for Electrical Systems."

D. Maintain minimum clearances and workspace at equipment in accordance with manufacturer's published instructions and IEEE C2.

3.3 CONNECTIONS

A. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
   1. For counterpoise, use tinned bare copper cable not smaller than 4/0 AWG, buried not less than 30 inch (765 mm) below grade interconnecting grounding electrodes. Bond surge arrester and neutrals directly to transformer enclosure and then to grounding electrode system with bare copper conductors, sized as shown. Keep lead lengths as short as practicable, with no kinks or sharp bends.
   2. Fence and equipment connections may not be smaller than 4 AWG. Ground fence at gate posts and corner posts and at intervals not exceeding 10 ft (3 m). Bond gate sections to fence posts using 1/8 by 1 inch (3 by 25 mm)flexible braided copper strap and clamps.
   3. Make joints in grounding conductors and loops by exothermic weld or compression connector.
   4. Terminate grounding and bonding conductors on common equipment grounding terminal on transformer enclosure.
   5. Complete transformer tank grounding and lightning arrester connections prior to making other electrical connections.

B. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
   1. Maintain air clearances between energized live parts and between live parts and ground for exposed connections in accordance with manufacturer recommendations.
   2. Bundle associated phase, neutral, and equipment grounding conductors together within transformer enclosure. Arrange conductors such that there is not excessive strain that could cause loose connections. Allow adequate slack for expansion and contraction of conductors.

C. Terminate medium-voltage cables in incoming section of transformers in accordance with Section 260513 "Medium-Voltage Cables."

3.4 SIGNS AND LABELS

A. Comply with installation requirements for labels and signs specified in Section 260553 "Identification for Electrical Systems."

B. Install warning signs as required to comply with 29 CFR 1910.269.

3.5 FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. General Field-Testing Requirements:
      a. Comply with provisions of "Testing and Test Methods" Chapter in NFPA 70B.
      b. Perform visual and mechanical inspections and electrical tests. Certify compliance with test parameters.
      c. After installing transformer but before primary is energized, verify that grounding system at transformer is tested at specified value or less.

d. After installing transformer and after electrical circuitry has been energized, test for compliance with requirements.
e. Visual and Mechanical Inspection:
1) Verify equipment nameplate data complies with Contract Documents.
2) Inspect bolted electrical connections for high resistance using one of the following two methods:
a) Use low-resistance ohmmeter to compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of lowest value.
b) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS, Table 100.12. Bolt-torque levels must be in accordance with manufacturer's published data. In absence of manufacturer's published data, use NETA ATS, Table 100.12.

2. Medium-Voltage Surge Arrester Field Tests:
a. Visual and Mechanical Inspection:
1) Inspect physical and mechanical condition.
2) Verify arresters are clean.
3) Verify that ground leads on devices are individually attached to ground bus or ground electrode.
b. Electrical Test:
1) Perform insulation-resistance test on arresters, phase terminal-to-ground. Apply voltage in accordance with manufacturer's published data. In absence of manufacturer's published data, comply with NETA ATS, Table 100.1. Replace units that fail to comply with recommended minimum insulation resistance listed in that table.
2) Perform watts-loss test. Evaluate watts-loss values by comparison with similar units and test equipment manufacturer's published data.

3. Liquid-Filled Transformer Field Tests:
a. Visual and Mechanical Inspection:
1) Test dew point of tank gases if applicable.
2) Inspect anchorage, alignment, and grounding.
3) Verify bushings are clean.
4) Verify that alarm and trip settings on temperature and level indicators are set and operate within manufacturer's recommended settings.
5) Verify that liquid level in tanks is within manufacturer's published tolerances.
6) Perform specific inspections and mechanical tests recommended by manufacturer.
7) Verify presence of transformer surge arresters and that their ratings are as specified.
8) Verify that as-left tap connections are as specified.
b. Electrical Tests:
1) Perform insulation-resistance tests winding-to-winding and windings-to-ground. Apply voltage in accordance with manufacturer's published data. In absence of manufacturer's published data, comply with NETA ATS, Table 100.5. Calculate polarization index; value of index may not be less than 1.0.

2) Perform power-factor or dissipation-factor tests on windings in accordance with test equipment manufacturer's published data. Maximum winding insulation power-factor/dissipation-factor values must be in accordance with manufacturer's published data. In absence of manufacturer's published data, comply with NETA ATS, Table 100.3.
3) Measure core insulation resistance at 500 V(dc) if core is insulated and core ground strap is removable. Core insulation-resistance values may not be less than 1 MΩ at 500 V(dc).
4) Perform power-factor or dissipation-factor tip-up test on windings greater than 2.5 kV.
5) Perform Optional Field Tests:
    a) Perform turns-ratio tests at tap positions. Turns-ratio test results may not deviate by more than one-half percent from either adjacent coils or calculated ratio. If test fails, replace transformer.
    b) Perform excitation-current test on each phase. Typical excitation-current test data pattern for three-legged core transformer is two similar current readings and one lower current reading. Investigate and correct if test shows different pattern.
    c) Measure resistance of windings at tap connections, and record temperature-corrected winding-resistance values in Operations and Maintenance Manual.
    d) Perform applied-voltage test on line- and load-side windings-to-ground. Comply with IEEE C57.12.91, Sections 10.2 and 10.9. This test is not required for single-phase transformers and for three-phase wye-wye-connected transformers.
6) Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.
7) Remove sample of insulating liquid in accordance with ASTM D923, and perform dissolved-gas analysis in accordance with IEEE C57.104 or ASTM D3612.

B. Nonconforming Work:
    1. Equipment and devices will be considered defective if they do not pass tests and inspections.
    2. Remove and replace malfunctioning units and retest.

C. Prepare test and inspection reports. Record as-left set points of adjustable devices.

END OF SECTION

SECTION 262413 – SWITCHBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Switchboards.
2. Surge protection devices.
3. Disconnecting and overcurrent protective devices.
4. Instrumentation.
5. Accessory components and features.

B. Related Requirements
1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260573.19 "Arc-Flash Hazard Analysis" for arc-flash analysis and arc-flash label requirements.

1.2 COORDINATION

A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.3 ACTION SUBMITTALS

A. Product Data:
1. Switchboards.
2. Overcurrent protective devices.
3. Surge protection devices.
4. Groud-fault protection devices.
5. Accessories.
6. Other components.
7. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

B. Shop Drawings: For each switchboard and related equipment.
1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types for types other than UL 50E, Type 1.

3. Detail bus configuration, current, and voltage ratings.
4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.
6. Include evidence of listing, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for series rating of installed devices.
7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
8. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
9. Include schematic and wiring diagrams for power, signal, and control wiring.

C. Field Quality-Control Submittals:
   1. Field Quality-Control Reports:
      a. Test procedures used.
      b. Test results that comply with requirements.
      c. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturers' Published Instructions: Record copy of official installation and testing instructions issued to Installer by manufacturer for the following:
   1. Handling and storage.
   2. Mounting accessories and anchoring devices.
   3. Testing and adjusting overcurrent protective devices.

B. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Warranty documentation.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Special Tools: Furnish to Owner proprietary equipment, keys, and software required to operate, maintain, repair, adjust, or implement future changes to switchboards, that are packaged with protective covering for storage on-site and identified with labels describing contents.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.

B. Remove loose packing and flammable materials from inside switchboards and to prevent condensation.

C. Handle and prepare switchboards for installation in accordance with NECA 400.

PART 2 - PRODUCTS

2.1 SWITCHBOARDS

A. Subject to compliance with additional requirements, provide switchboards by the following manufacturers:
1. ABB
2. Square D
3. Eaton
4. Siemens
5. Or approved equal.

B. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

E. Comply with NEMA PB 2.

F. Comply with NFPA 70.

G. Comply with UL 891.

H. Front-Connected, Front-Accessible Switchboards:
1. Main Devices: Panel mounted.
2. Branch Devices: Panel mounted.
3. Sections front and rear aligned.

I. Nominal System Voltage: 480Y/277 V or 208Y/120 V as indicated on drawings.

J. Main-Bus Continuous: as indicated on drawings.

K. Indoor Enclosures: Steel, UL 50E, Type 1.

L. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over rust-inhibiting primer on treated metal surface.

M. Barriers: Between adjacent switchboard sections.

N. Insulation and isolation for main and vertical buses of feeder sections.

O. Service Entrance Rating: Switchboards intended for use as service entrance equipment may contain from one to six service disconnecting means with overcurrent protection, neutral bus with disconnecting link, grounding electrode conductor terminal, and main bonding jumper.

P. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.

Q. Buses and Connections: Three phase, four wire unless otherwise indicated.
1. Provide phase bus arrangement A, B, C from front to back, top to bottom, and left to right when viewed from front of switchboard.
2. Phase- and Neutral-Bus Material:
   a. Hard-drawn copper of 98 percent conductivity, silver-plated.
3. Copper feeder circuit-breaker line connections.
4. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with mechanical connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.
5. Ground Bus: 1/4 by 2 inch (6 by 50 mm-) hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors.
6. Main-Phase Buses and Equipment-Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
7. Disconnect Links:
   a. Isolate neutral bus from incoming neutral conductors.
   b. Bond neutral bus to equipment-ground bus for switchboards utilized as service equipment or separately derived systems.
8. Neutral Buses: 100 percent of ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
9. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.

R. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

S. Bus-Bar Insulation: Factory-applied, flame-retardant, tape wrapping of individual bus bars or flame-retardant, spray-applied insulation. Minimum insulation temperature rating of 105 deg C.

T. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components including instruments and instrument transformers.

2.2 SURGE PROTECTION DEVICES

A. SPDs: Listed and labeled in accordance with UL 1449, Type 2.

B. Features and Accessories:
1. Integral disconnect switch.

2. Internal thermal protection that disconnects SPD before damaging internal suppressor components.
3. Indicator light display for protection status.
4. Form-C contacts rated at 5 A and 250 V(ac), one normally open and one normally closed, for remote monitoring of protection status.
5. Surge counter.

C. Peak Surge Current Rating: Minimum single-pulse surge current withstand rating per phase may not be less than 200 kA. Peak surge current rating must be arithmetic sum of ratings of individual MOVs in each mode.

D. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V or 208Y/120 V, three-phase, four-wire circuits may not exceed the following:
1. Line to Neutral: 1200 V for 480Y/277 V; 700 V for 208Y/120 V.
2. Line to Ground: 1200 V for 480Y/277 V; 1200 V for 208Y/120 V.
3. Line to Line: 2000 V for 480Y/277 V; 1000 V for 208Y/120 V.

E. Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits may 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. Nominal Rating: 20 kA.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 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 with RMS sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
   a. Instantaneous trip.
   b. Long- and short-time pickup levels.
   c. Long and short time adjustments.
   d. 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. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
6. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6 mA trip).

7. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30 mA trip).
8. MCCB Features and Accessories:
    a. Standard frame sizes, trip ratings, and number of poles.
    b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
    c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
    d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    e. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
    f. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system specified in Section 260913 "Electrical Power Monitoring and Control."
    g. Shunt Trip: 120 V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
    h. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
    i. 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.
    j. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key must be removable only when circuit breaker is in off position.

2.4 INSTRUMENTATION

A. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
    a. Phase Currents, Each Phase: Plus or minus 0.5 percent.
    b. Phase-to-Phase Voltages, Three Phase: Plus or minus 0.5 percent.
    c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 0.5 percent.
    d. Megawatts: Plus or minus 1 percent.
    e. Megavars: Plus or minus 1 percent.
    f. Power Factor: Plus or minus 1 percent.
    g. Frequency: Plus or minus 0.1 percent.
    h. Accumulated Energy, Megawatt Hours: Plus or minus 1 percent; accumulated values unaffected by power outages up to 72 hours.
    i. Megawatt Demand: Plus or minus 1 percent; demand interval programmable from five to 60 minutes.
    j. Contact devices to operate remote impulse-totalizing demand meter.
2. Mounting: Display and control unit flush or semi flush mounted in instrument compartment door.

2.5 ACCESSORY COMPONENTS AND FEATURES

A. Mounting Accessories: For anchors, mounting channels, bolts, washers, and other mounting accessories, comply with requirements in Section 260548 "Vibration and Seismic Controls for Electrical Systems" or manufacturer's instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store switchboards in accordance with NECA 400.
   1. Lift or move panelboards with spreader bars and manufacturer-supplied lifting straps following manufacturer's published instructions.
   2. Use rollers, slings, or other manufacturer-approved methods if lifting straps are not furnished.
   3. Protect from moisture, dust, dirt, and debris during storage and installation.

B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.

C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work or that affect performance of equipment.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

3.3 INSTALLATION

A. Comply with manufacturer's published instructions.

B. Reference Standards:
   1. Switchboards and Accessories: Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NECA 400.
   2. Consult Architect for resolution of conflicting requirements.

C. Special Techniques:
   1. Equipment Mounting: Install switchboards on concrete base, 4 inch (100 mm) nominal thickness. Comply with requirements for concrete base specified in Section 260529 "Hangers and Supports for Electrical Systems."
      a. Install conduits entering underneath switchboard, entering under vertical section where conductors will terminate. Install with couplings flush with

concrete base. Extend 2 inch (50 mm) above concrete base after switchboard is anchored in place.

b. 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 concrete base.

c. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

d. Place and secure anchorage devices. Use setting drawings, templates, diagrams, published instructions, and directions furnished with items to be embedded.

e. Install anchor bolts to elevations required for proper attachment to switchboards.

2. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, straps and brackets, and temporary blocking of moving parts from switchboard units and components.
3. Comply with mounting and anchoring requirements specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
4. Operating Instructions: Frame and mount printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
5. Install filler plates in unused spaces of panel-mounted sections.
6. Install overcurrent protective devices, surge protection devices, and instrumentation.
   a. Set field-adjustable switches and circuit-breaker trip ranges.
7. Install spare-fuse cabinet.

3.4 CONNECTIONS

A. Bond conduits entering underneath switchboard to equipment ground bus with bonding conductor sized in accordance with NFPA 70.

B. Support and secure conductors within switchboard in accordance with NFPA 70.

C. Extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.

3.5 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Switchboard Nameplates: Label each switchboard compartment with nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with nameplate

complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Service Equipment Label: Labeled, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

3.6 FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. Acceptance Testing:
      a. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit. Open control and metering circuits within switchboard, and remove neutral connection to surge protection and other electronic devices prior to insulation test. Reconnect after test.
      b. Test continuity of each circuit.
   2. Test ground-fault protection of equipment for service equipment in accordance with NFPA 70.
   3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   4. Correct malfunctioning units on-site where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
   5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

B. Nonconforming Work:
   1. Switchboard will be considered defective if it does not pass tests and inspections.
   2. Remove and replace defective units and retest.

C. Collect, assemble, and submit test and inspection reports, including certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

D. Manufacturer Services:
   1. Engage factory-authorized service representative to support field tests and inspections.

3.7 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Coordination Studies."

END OF SECTION

SECTION 262416 – PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Power panelboards.
   2. Disconnecting and overcurrent protective devices.

B. Related Requirements:
   1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 DEFINITIONS

A. GFEP: Ground-fault equipment protection.

B. MCCB: Molded-case circuit breaker.

C. VPR: Voltage protection rating.

1.3 ACTION SUBMITTALS

A. Product Data:
   1. Power panelboards.
   2. Disconnecting and overcurrent protective devices.
   3. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
   4. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.
   1. Include dimensioned plans, elevations, sections, and details.
   2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
   3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
   4. Detail bus configuration, current, and voltage ratings.
   5. Short-circuit current rating of panelboards and overcurrent protective devices.
   6. Include evidence of listing, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for series rating of installed devices.
   7. Include evidence of listing, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for SPD as installed in panelboard.

8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
9. Include wiring diagrams for power, signal, and control wiring.
10. Key interlock scheme drawing and sequence of operations.
11. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

C. Field Quality-Control Submittals:
1. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

A. Panelboard Schedules: For installation in panelboards.

B. Manufacturers' Published Instructions: Record copy of official installation and testing instructions issued to Installer by manufacturer for the following:
1. Recommended procedures for installing panelboards.
2. Recommended torque settings for bolted connections on panelboards.
3. Recommended temperature range for energizing panelboards.

C. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Warranty documentation.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Spare Parts: Furnish to Owner spare parts, for repairing panelboards, that are packaged with protective covering for storage on-site and identified with labels describing contents. Include the following:
1. Keys: Two spares for each type of panelboard cabinet lock.

B. Special Tools: Furnish to Owner proprietary equipment, keys, and software required to operate, maintain, repair, adjust, or implement future changes to panelboards, that are packaged with protective covering for storage on-site and identified with labels describing contents.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards.

B. Handle and prepare panelboards for installation in accordance with NECA 407.

PART 2 - PRODUCTS

2.1 PANELBOARDS REQUIREMENTS

A. Fabricate and test panelboards in accordance with IEEE 344 to withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems."

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing agency recognized by authorities having jurisdiction, and marked for intended location and application.

D. Comply with NEMA PB 1.

E. Comply with NFPA 70.

F. Enclosures: Flush and Surface-mounted, dead-front cabinets.
   1. Rated for environmental conditions at installed location.
      a. Indoor Dry and Clean Locations: UL 50E, Type 1.
      b. Outdoor Locations: UL 50E, Type 3R.
      c. Kitchen Areas: UL 50E, Type 1.
      d. Other Wet or Damp Indoor Locations: UL 50E, Type 3R.
      e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: UL 50E, Type 12.
   2. Height: 7 ft (2.13 m) maximum.
   3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims must cover live parts and may have no exposed hardware.
   4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims must cover live parts and may have no exposed hardware.
   5. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
   6. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
   7. Finishes:
      a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
      b. Back Boxes: Same finish as panels and trim.
      c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.

G. Incoming Mains:
   1. Location: Bottom or top.
   2. Main Breaker: Main lug interiors up to 400 A must be field convertible to main breaker.

H. Phase, Neutral, and Ground Buses:
   1. Material: Hard-drawn copper, 98 percent conductivity.
      a. Plating must run entire length of bus.
      b. Bus must be fully rated for entire length.
   2. Interiors must be factory assembled into unit. Replacing switching and protective devices may not disturb adjacent units or require removing main bus connectors.
   3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
   4. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
   5. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure.
   6. Do not mount neutral bus in gutter.
   7. Split Bus: Vertical buses divided into individual vertical sections.

I. Conductor Connectors: Suitable for use with conductor material and sizes.
   1. Material: Hard-drawn copper, 98 percent conductivity.
   2. Terminations must allow use of 75 deg C rated conductors without derating.
   3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
   4. Main and Neutral Lugs: Mechanical type, with lug on neutral bar for each pole in panelboard.
   5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with lug on bar for each pole in panelboard.
   6. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
   7. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
   8. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.
   9. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

J. Quality-Control Label: Panelboards must be labeled, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for use as service equipment with one or more main service disconnecting and overcurrent protective devices.

K. Future Devices: Panelboards must have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
   1. Percentage of Future Space Capacity: 20 percent.

L. Panelboard Short-Circuit Current Rating:
   1. Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by qualified electrical testing laboratory recognized by authorities having jurisdiction. Include label or manual with size and type of allowable upstream and branch devices listed and labeled, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for series-connected short-circuit rating.
      a. Panelboards rated 240 V or less must have short-circuit ratings as shown on Drawings, but not less than 10 000 A(rms) symmetrical.

b. Panelboards rated above 240 V and less than 600 V must have short-circuit ratings as shown on Drawings, but not less than 14 000 A(rms) symmetrical.

2. Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for 100 percent interrupting capacity.
   a. Panelboards and overcurrent protective devices rated 240 V or less must have short-circuit ratings as shown on Drawings, but not less than 10 000 A(rms) symmetrical.
   b. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V must have short-circuit ratings as shown on Drawings, but not less than 14 000 A(rms) symmetrical.

M. Surge Suppression: Factory installed as integral part of indicated panelboards, complying with UL 1449 SPD Type 2.

2.2 POWER PANELBOARDS

A. Subject to compliance with additional requirements, provide panelboards by the following manufacturers:
   1. ABB
   2. Square D
   3. Eaton
   4. Siemens
   5. Or approved equal.

B. Listing Criteria: NEMA PB 1, distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
   1. For doors more than 36 inch (914 mm) high, provide two latches, keyed alike.

D. Mains: as indicated on drawings.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

G. Circuit breakers serving all dormitory bedrooms, corridors, study rooms, and bathrooms must be Arc Fault Circuit Interrupting (AFCI) type.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Subject to compliance with additional requirements, provide panelboards by the following manufacturers:
   1. ABB
   2. Square D
   3. Eaton
   4. Siemens
   5. Or approved equal

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 must be recorded with type, phase, and magnitude of fault that caused 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. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6 mA trip).
   6. GFEP Circuit Breakers: Class B ground-fault protection (30 mA trip).
   7. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240 V, single-pole configuration.
   8. Subfeed Circuit Breakers: Vertically mounted.
   9. 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. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
      g. Communication Capability: Circuit-breaker-mounted Integral communication module with functions and features compatible with power monitoring and control system specified in Section 260913 "Electrical Power Monitoring and Control."
      h. Shunt Trip: 120 V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
      i. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.

j. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
k. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
l. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 A must have interchangeable rating plugs or electronic adjustable trip units.
m. Auxiliary Contacts: One, SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
n. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
o. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key must be removable only when circuit breaker is in off position.
p. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
q. Multipole units enclosed in single housing with single handle.

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. Fused Switch Features and Accessories:
a. Standard ampere ratings and number of poles.
b. Mechanical cover interlock with manual interlock override, to prevent opening of cover when switch is in on position. Interlock must prevent switch from being turned on with cover open. Operating handle must have lock-off means with provisions for three padlocks.
c. Auxiliary Contacts: One normally open and normally closed contact(s) that operate with switch handle operation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.

B. Receive, inspect, handle, and store panelboards in accordance with NECA 407.

C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.

D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's published instructions.

B. Reference Standards:
1. Panelboards: Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NECA 407.
2. Consult Architect for resolution of conflicting requirements.

C. Special Techniques:
1. Equipment Mounting:
a. Install panelboards on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
b. Attach panelboard to vertical finished or structural surface behind panelboard.
c. Mount surface-mounted panelboards to steel slotted supports 5/8 inch (16 mm) in depth. Orient steel slotted supports vertically.
d. Comply with requirements for seismic control devices specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
2. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
3. Comply with mounting and anchoring requirements specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
4. Mount top of trim 7.5 ft (2.3 m) above finished floor unless otherwise indicated.
5. Mount panelboard cabinet plumb and rigid without distortion of box.
6. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
7. Install overcurrent protective devices and controllers not already factory installed.
a. Set field-adjustable, circuit-breaker trip ranges.
b. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver in accordance with manufacturer's published instructions.
8. 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.
9. Install filler plates in unused spaces.
10. Stub four 1 inch (25 mm) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in future. Stub four 1 inch (25 mm) empty conduits into raised floor space or below slab not on grade.
11. Arrange conductors in gutters into groups and bundle and wrap with wire ties.
12. Mount spare fuse cabinet in accessible location.

D. Interfaces with Other Work:
1. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."

B. Panelboard Nameplates: Label each panelboard with nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

C. Device Nameplates: Label each branch circuit device in power panelboards with nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

E. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles must be located on interior of panelboard door.

F. Breaker Labels: Faceplate must list current rating, UL and IEC certification standards, and AIC rating.

G. Circuit Directory:
   1. Provide directory card inside panelboard door, mounted in transparent card holder.
      a. Circuit directory must identify specific purpose with detail sufficient to distinguish it from other circuits.
   2. Provide computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.
      a. Circuit directory must identify specific purpose with detail sufficient to distinguish it from other circuits.
   3. Create 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.

3.4 FIELD QUALITY CONTROL

A. Acceptance Testing Preparation:
   1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

B. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers and low-voltage surge arrestors stated in NETA ATS, Paragraph 7.6 Circuit Breakers and Paragraph 7.19.1 Surge Arrestors, Low-Voltage. Do not perform optional tests. 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.

C. Nonconforming Work:
   1. Panelboards will be considered defective if they do not pass tests and inspections.
   2. Remove and replace defective units and retest.

D. Collect, assemble, and submit test and inspection reports, including certified report that identifies panelboards included and that describes testing results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Coordination Studies."

END OF SECTION

SECTION 262713 – ELECTRICITY METERING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Electricity meters.
   2. Work to accommodate Owner's electricity meters used to manage electrical power system.

B. Related Requirements:
   1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 DEFINITIONS

A. KY or KYZ Pulse: Term used by metering industry to describe method of measuring consumption of electricity (kWh) that is based on relay opening and closing in response to rotation of disk in meter. Electronic meters generate pulses electronically.

1.3 ACTION SUBMITTALS

A. Product Data:
   1. For each type of meter.
   2. For metering infrastructure components.
   3. For metering software.

B. Shop Drawings: For electricity-metering equipment.
   1. Include elevation views of front panels of control and indicating devices and control stations.
   2. Include diagrams for power, signal, and control wiring.
   3. Wire Termination Diagrams and Schedules: Include diagrams for power, signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features. Differentiate between manufacturer-installed and field-installed wiring.
   4. Include series-combination rating data for modular meter centers with main disconnect device.
   5. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices used. Describe characteristics of network and other data communication lines.

6. Submit evidence that meters are compatible with connected monitoring and control devices and systems specified in Section 260913 "Electrical Power Monitoring and Control."
    a. Show interconnecting signal and control wiring, and interface devices to show compatibility of meters.
    b. For reporting interfaces and adapters, list network protocols and provide statements from manufacturers that input and output devices comply with interoperability requirements of the protocol.

C. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturers' Published Instructions: Record copy of official installation and testing instructions issued to Installer by manufacturer for the following:
    1. Installation of metering equipment.

B. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Contracts:
    1. Software and firmware service agreement.

B. Warranty documentation.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

B. Comply with UL 916.

2.2 ELECTRICITY METERS

A. System Description: Able to meter designated activity loads, with or without external alarm, control, and communication capabilities, or other optional features.

B. General Requirements for Meters:
    1. Comply with NEMA ANSI C12.1 and NEMA ANSI C12.20, 0.2 accuracy class.
    2. Ambient Temperature: Minus 22 deg F to plus 158 deg F (Minus 30 deg C to plus 70 deg C).
    3. Humidity: Zero to 95 percent, noncondensing.
    4. Capacities and Characteristics:

a. Circuit: 120/240 V(ac), 100 A.
b. Measure: kWh, onboard LED display.
c. Remote-Reading Options: None.

5. Meter Accuracy: 0.2 percent of reading, complying with NEMA ANSI C12.20.
6. Meter Certification: Certified by California Type Evaluation Program as complying with 4 CCR 4027, Article 2.2.
7. Certify that meters comply with NEMA ANSI C12.20 requirements by laboratory accredited by the National Voluntary Laboratory Accreditation Program (NVLAP) of the National Institute of Standards and Technology (NIST). Laboratory must use test equipment that is certified annually and is traceable to NIST standards.
8. Enclosure: Supplied by meter manufacturer, UL 50E, Type 1 minimum, with provisions for locking or sealing.
9. Identification: Comply with requirements in Section 260553 "Identification for Electrical Systems."
10. Onboard Nonvolatile Data Storage: kWh, until reset.
11. Sensors: Current-sensing type, supplied by electronic meter manufacturer, with current or voltage output, selected for optimum range and accuracy for meters indicated for this application.
    a. Type: Split and solid core, complying with recommendation of meter manufacturer.

C. kWhd Meter: Electronic three-phase meters, measuring electricity use and demand. Demand must be integrated over 15-minute interval.
1. Voltage and Phase Configuration: Meter must be designed for use on circuits with voltage rating and phase configuration indicated for its application.
2. Display: LCD with characters not less than 0.25 inch (6 mm) high, indicating the following:
    a. Accumulative kWh.
    b. Current time and date.
    c. Current demand.
    d. Historic peak demand.
    e. Time and date of historic peak demand.
3. Retain accumulated kWh and historic peak demand in nonvolatile memory, until reset.

D. Remote Reading Options:
1. Pulse Output: KYZ, complete with optical sensor and interface devices.
2. TIA-232 serial interface.
3. TIA-485 serial interface, with Modbus RTU protocol.
4. USB interface.
5. TCP/IP adapter.

E. Data Transmission Cable: Comply with requirements in Section 260523 "Control-Voltage Electrical Power Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's published instructions.

B. Reference Standards:
1. Install modular meter center according to switchboard installation requirements in NECA 400.
2. Install arc-flash labels as required by NFPA 70.

C. Special Techniques:
1. Wiring Methods:
a. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533.13 "Conduits for Electrical Systems."
b. Install unshielded, twisted-pair cable for control and signal transmission conductors, complying with Section 271513 "Communications Copper Horizontal Cabling."
c. Minimum conduit size is metric designator 16 (trade size 1/2).

3.2 IDENTIFICATION

A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
1. Series Combination Warning Label: Self-adhesive labels, with text as required by NFPA 70.
2. Equipment Identification Labels: Self-adhesive labels with clear protective overlay. For residential meters, provide additional card holder suitable for typewritten card with occupant's name.

3.3 FIELD QUALITY CONTROL

A. Tests and Inspections:
1. Equipment and Software Setup:
a. Set meter date and time clock.
b. Test, calibrate, and connect pulse metering system.
c. Set and verify demand interval for demand meters.
d. Report settings and calibration results.
2. Connect load of known power rating, 1.5 kW minimum, to circuit supplied by metered feeder.
3. Turn off circuits supplied by metered feeder and secure them in off condition.
4. Run test load continuously for eight hours minimum, or longer, to obtain measurable meter indication. Use test-load placement and setting that ensures continuous, safe operation.
5. Check and record meter reading at end of test period and compare with actual electricity used, based on test-load rating, duration of test, and sample measurements of supply voltage at test-load connection. Record test results.

B. Nonconforming Work:
   1. Electricity metering will be considered defective if it does not pass tests and inspections.
   2. Remove and replace defective units and retest.

C. Collect, assemble, and submit test and inspection reports.

D. Manufacturer Services:
   1. Engage factory-authorized service representative to support field tests and inspections.

3.4 PROTECTION

A. After installation, protect metering equipment from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

3.5 MAINTENANCE

A. Software and Firmware Service Agreement:
   1. Technical Support: Beginning at Substantial Completion, verify that software and firmware service agreement includes software and firmware support for two years.
   2. Upgrade Service: At Substantial Completion, update software and firmware to latest version. Install and program software and firmware upgrades that become available within two years from date of Substantial Completion.
      a. Upgrade Notice: No fewer than 30 days to allow Owner to schedule and access the system
   3. Upgrade Reports: Prepare report after each update, documenting upgrades installed.

END OF SECTION

SECTION 262726 – WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. General-use switches.
2. General-grade duplex straight-blade receptacles.
3. Locking receptacles.
4. Special-purpose power outlet assemblies.
5. Connectors, cords, and plugs.

B. Related Requirements:
1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260943.16 "Network Lighting Controls" for network lighting control solid-state devices.

1.2 ACTION SUBMITTALS

A. Product Data:
1. General-use switches.
2. General-grade duplex straight-blade receptacles.
3. Locking receptacles.

B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 GENERAL-USE SWITCHES

A. Toggle Switch:
1. Regulatory Requirements:
a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. General Characteristics:
a. Reference Standards: UL CCN WMUZ and UL 20.
3. Options:
a. Device Color: As indicated on architectural Drawings.
b. Configuration:
1) Extra-heavy-duty, 120-277 V, 20 A, single pole, double pole, three way, and/or four way as indicated on drawings.
4. Accessories:

a. Cover Plate: 0.060 inch (1.5 mm) thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

2.2 GENERAL-GRADE DUPLEX STRAIGHT-BLADE RECEPTACLES

A. Duplex Straight-Blade Receptacle:
1. Regulatory Requirements:
a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. General Characteristics:
a. Reference Standards: UL CCN RTRT and UL 498.
3. Options:
a. Device Color: As indicated on architectural Drawings.
b. Configuration:
1) Heavy-duty, NEMA type as indicated on drawings.
4. Accessories:
a. Cover Plate: 0.060 inch (1.5 mm) thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

B. Tamper-Resistant Duplex Straight-Blade Receptacle:
1. Regulatory Requirements:
a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. General Characteristics:
a. Reference Standards: UL CCN RTRT and UL 498.
3. Options:
a. Device Color: As indicated on architectural Drawings.
b. Configuration:
1) Heavy-duty, smooth face, NEMA 5-20R.
4. Accessories:
a. Cover Plate: 0.060 inch (1.5 mm) thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

C. Wired Half-Controlled Duplex Straight-Blade Receptacle:
1. Regulatory Requirements:
a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. General Characteristics:

a. Reference Standards: UL CCN RTXI and UL Subject 498B.
3. Options:
a. Device Color As indicated on architectural Drawings.
b. Configuration: NEMA 5-20R.
4. Accessories:
a. Cover Plate: 0.060 inch (1.5 mm) thick, high-impact thermoplastic (nylon) with smooth finish and color matching wiring device; from same manufacturer as wiring device.
b. Securing Screws for Cover Plate: Metal with head color matching wallplate finish.

2.3 LOCKING RECEPTACLES

A. NEMA, 250 V, Locking Receptacle:
1. Regulatory Requirements:
a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. General Characteristics:
a. Reference Standards: UL CCN RTRT and UL 498.
3. Options:
a. Device Color: Black with yellow voltage indication on face.
b. Configuration: Heavy-Duty, grounding, NEMA type as indicated on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receptacles:
1. Verify that receptacles to be procured and installed for Owner-furnished equipment are compatible with mating attachment plugs on equipment.

3.2 INSTALLATION OF SWITCHES

A. Comply with manufacturer's instructions.

B. Reference Standards:
1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
3. Consult Architect for resolution of conflicting requirements.

C. Identification:
1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."

a. Mark cover or cover plate using hot, stamped, or engraved machine printing with black-filled lettering, and provide durable wire markers or tags inside device box or outlet box.

3.3 INSTALLATION OF STRAIGHT-BLADE RECEPTACLES

A. Comply with manufacturer's instructions.

B. Reference Standards:
1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
3. Receptacle Orientation: Unless otherwise indicated in Contract Documents, orient receptacle to match configuration diagram in NEMA WD 6.
4. Consult Architect for resolution of conflicting requirements.

C. Identification:
1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."
   a. Mark cover or cover plate using hot, stamped, or engraved machine printing with black-filled lettering, and provide durable wire markers or tags inside device box or outlet box.
   b. Healthcare Facilities: Distinctively identify covers or cover plates of device boxes and outlet boxes that are supplied from life safety and critical branch power supplies following facility's standard practice.

3.4 INSTALLATION OF LOCKING RECEPTACLES

A. Comply with manufacturer's instructions.

B. Reference Standards:
1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
3. Receptacle Orientation: Unless otherwise indicated in Contract Documents, orient receptacle to match configuration diagram in NEMA WD 6.
4. Consult Architect for resolution of conflicting requirements.

C. Identification:
1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."
   a. Mark cover or cover plate using hot, stamped, or engraved machine printing with black-filled lettering, and provide durable wire markers or tags inside device box or outlet box.

3.5 FIELD QUALITY CONTROL OF SWITCHES

A. Tests and Inspections:
1. Perform tests and inspections in accordance with manufacturers' instructions.

B. Nonconforming Work:
1. Unit will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

C. Assemble and submit test and inspection reports.

3.6 FIELD QUALITY CONTROL OF STRAIGHT-BLADE RECEPTACLES

A. Tests and Inspections:
1. Insert and remove test plug to verify that device is securely mounted.
2. Verify polarity of hot and neutral pins.
3. Measure line voltage.
4. Measure percent voltage drop.
5. Measure grounding circuit continuity; impedance must be not greater than 2 ohms.
6. Perform additional installation and maintenance inspections and diagnostic tests in accordance with NECA NEIS 130 and manufacturers' instructions.

B. Nonconforming Work:
1. Device will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

C. Assemble and submit test and inspection reports.

D. Manufacturer Services:
1. Engage factory-authorized service representative to support field tests and inspections.

3.7 FIELD QUALITY CONTROL OF LOCKING RECEPTACLES

A. Tests and Inspections:
1. Insert and remove test plug to verify that device is securely mounted.
2. Verify polarity of hot and neutral pins.
3. Measure line voltage.
4. Measure percent voltage drop.
5. Measure grounding circuit continuity; impedance must be not greater than 2 ohms.
6. Perform additional installation and maintenance inspections and diagnostic tests in accordance with NECA NEIS 130 and manufacturers' instructions.

B. Nonconforming Work:
1. Device will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

C. Assemble and submit test and inspection reports.

3.8 PROTECTION

A. Devices:
   1. Schedule and sequence installation to minimize risk of contamination of wires and cables, devices, device boxes, outlet boxes, covers, and cover plates by plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other materials.
   2. After installation, protect wires and cables, devices, device boxes, outlet boxes, covers, and cover plates from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION

SECTION 262813 – FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings 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. Cartridge fuses rated 600 V ac and less for use in the following:
      a. Control circuits.
      b. Enclosed controllers.
      c. Enclosed switches.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
   1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
      a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
      b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
   2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
   3. Current-limitation curves for fuses with current-limiting characteristics.
   4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit in PDF format.
   5. Coordination charts and tables and related data.
   6. Fuse sizes for elevator feeders and elevator disconnect switches.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
   1. Ambient temperature adjustment information.
   2. Current-limitation curves for fuses with current-limiting characteristics.

3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse used on the Project. Submit in PDF format.
4. Coordination charts and tables and related data.

1.5 FIELD CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

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: 600-V, zero- to 600-A rating, 200 kAIC.
2. Type RK-5: 600-V, zero- to 600-A rating, 200 kAIC.
3. Type CC: 600-V, zero- to 30-A rating, 200 kAIC.
4. Type CD: 600-V, 31- to 60-A rating, 200 kAIC.
5. Type J: 600-V, zero- to 600-A rating, 200 kAIC.
6. Type L: 600-V, 601- to 6000-A rating, 200 kAIC.
7. Type T: 600-V, zero- to 800-A rating, 200 kAIC.

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 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:
   1. Motor Branch Circuits: Class RK5, time delay.
   2. Large Motor Branch (601-4000 A): Class L, time delay.
   3. Control Transformer Circuits: Class CC, time delay, control transformer duty.
   4. Provide open-fuse indicator fuses or fuse covers with open fuse indication.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.4 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

SECTION 262816 – ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Fusible switches.
   2. Molded-case circuit breakers (MCCBs).
   3. Enclosures.

B. Related Requirements:
   1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 DEFINITIONS

A. GFEP: Ground-fault circuit-interrupter for equipment protection.

B. GFLS: Ground-fault circuit-interrupter for life safety.

C. SPDT: Single pole, double throw.

1.3 ACTION SUBMITTALS

A. Product Data:
   1. For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
   2. Enclosure types and details for types other than UL 50E, Type 1.
   3. Current and voltage ratings.
   4. Short-circuit current ratings (interrupting and withstand, as appropriate).
   5. Include evidence of qualified electrical testing laboratory listing for series rating of installed devices.
   6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
   7. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.

B. Shop Drawings: For enclosed switches and circuit breakers.
   1. Include plans, elevations, sections, details, and attachments to other work.
   2. Include wiring diagrams for power, signal, and control wiring.

C. Field Quality-Control Submittals:

1. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

A. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Warranty documentation.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Source Limitations: Obtain products from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.2 FUSIBLE SWITCHES

A. Type HD, Heavy Duty:
1. Single throw.
2. Three pole.
3. 600 V(ac).
4. 1200 A and smaller.
5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses.
6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

B. 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. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Service-Rated Switches: Labeled for use as service equipment.
6. Hookstick Handle: Allows use of hookstick to operate handle.

7. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 24 V(dc).
8. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 MOLDED-CASE CIRCUIT BREAKERS

A. Circuit breakers must be constructed using glass-reinforced insulating material. Current carrying components must be completely isolated from the handle and accessory mounting area.

B. Circuit breakers must have toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. Circuit-breaker handle must be over center, be trip free, and reside in tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon must be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with push-to-trip button, located on face of circuit breaker to mechanically operate circuit-breaker tripping mechanism for maintenance and testing purposes.

C. Maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings must be clearly marked on face of circuit breaker. Circuit breakers must be 100 percent rated or series rated as indicated on Drawings. Circuit breaker/circuit breaker and Fuse/circuit breaker combinations for series connected interrupting ratings must be listed by UL as recognized component combinations. Series rated combination used must be marked on end-use equipment along with statement "Caution - Series Rated System. _____ Amps Available. Identical Replacement Component Required."

D. MCCBs must be equipped with device for locking in isolated position.

E. Lugs must be suitable for 75 deg C rated wire.

F. Standard: Comply with UL 489 with required interrupting capacity for available fault currents.

G. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal 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.

H. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

I. 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-squared t response.

J. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

K. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.

L. GFLS Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6 mA trip).

M. GFEP Circuit Breakers: With Class B ground-fault protection (30 mA trip).

N. Features and Accessories:
1. Standard frame sizes, trip ratings, and number of poles.
2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
3. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
4. Alarm Switch: One NO contact that operates only when circuit breaker has tripped.
5. 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.
6. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
7. 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.
8. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system, specified in Section 260913 "Electrical Power Monitoring and Control."
9. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
10. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key must be removable only when circuit breaker is in off position.
11. Zone-Selective Interlocking: Integral with ground-fault trip unit; for interlocking ground-fault protection function.
12. Electrical Operator: Provide remote control for on, off, and reset operations.
13. Accessory Control Power: Integrally mounted, self-powered; 24 V(dc).

2.4 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, UL 50E, and UL 50, to comply with environmental conditions at installed location.

B. Enclosure Finish: Enclosure must be gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (UL 50E Type 1) or gray baked enamel paint, electrodeposited on cleaned, phosphatized galvannealed steel (UL 50E Types 3R, 12).

C. Conduit Entry: UL 50E Types 4, 4X, and 12 enclosures may not contain knockouts. UL 50E Types 7 and 9 enclosures must be provided with threaded conduit openings in both endwalls.

D. Operating Mechanism: Circuit-breaker operating handle must be externally operable with operating mechanism being integral part of box, not cover. Cover interlock mechanism must have externally operated override. Override may not permanently disable interlock mechanism, which must return to locked position once override is released. Tool used to override cover interlock mechanism must not be required to enter enclosure in order to override interlock.

E. Enclosures designated as UL 50E Type 4, 4X stainless steel, 12, or 12K must have dual cover interlock mechanism to prevent unintentional opening of enclosure cover when circuit breaker is ON and to prevent turning circuit breaker ON when enclosure cover is open.

F. UL 50E Type 7/9 enclosures must be furnished with breather and drain kit to allow their use in outdoor and wet location applications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.
   1. Commencement of work will indicate Installer's acceptance of areas and conditions as satisfactory.

3.2 SELECTION OF ENCLOSURES

A. Indoor, Dry and Clean Locations: UL 50E, Type 1.

B. Outdoor Locations: UL 50E, Type 3R.

C. Kitchen Areas: UL 50E, Type 4X.

D. Other Wet or Damp, Indoor Locations: UL 50E, Type 3R.

E. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: UL 50E, Type 12.

F. Hazardous Areas Indicated on Drawings: UL 50E, Type 7 with cover attached by Type 316 stainless steel bolts.

3.3 INSTALLATION

A. Comply with manufacturer's published instructions.

B. Special Techniques:

1. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
2. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
3. Comply with mounting and anchoring requirements specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
4. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
5. Install fuses in fusible devices.

3.4 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.

3.5 FIELD QUALITY CONTROL

A. Tests and Inspections for Switches:
   1. Visual and Mechanical Inspection:
      a. Inspect physical and mechanical condition.
      b. Inspect anchorage, alignment, grounding, and clearances.
      c. Verify that unit is clean.
      d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
      e. Verify that fuse sizes and types match the Specifications and Drawings.
      f. Verify that each fuse has adequate mechanical support and contact integrity.
      g. Inspect bolted electrical connections for high resistance using one of the following methods:
         1) Use low-resistance ohmmeter.
            a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of lowest value.
         2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
            a) Bolt-torque levels must be in accordance with manufacturer's published data. In absence of manufacturer's published data, use NETA ATS Table 100.12.
      h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on Drawings.
      i. Verify correct phase barrier installation.
      j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.

2. Electrical Tests:
    a. Perform resistance measurements through bolted connections with low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.
    b. Measure contact resistance across each switchblade fuseholder. Drop values may not exceed high level of manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.
    c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In absence of manufacturer's published data, use Table 100.1 from NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
    d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
    e. Perform ground fault test in accordance with NETA ATS Section 7.14 "Ground Fault Protection Systems, Low-Voltage."

B. Tests and Inspections for Molded-Case Circuit Breakers:
1. Visual and Mechanical Inspection:
    a. Verify that equipment nameplate data are as described in the Specifications and shown on Drawings.
    b. Inspect physical and mechanical condition.
    c. Inspect anchorage, alignment, grounding, and clearances.
    d. Verify that unit is clean.
    e. Operate circuit breaker to ensure smooth operation.
    f. Inspect bolted electrical connections for high resistance using one of the following methods:
        1) Use low-resistance ohmmeter.
            a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of lowest value.
        2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
            a) Bolt-torque levels must be in accordance with manufacturer's published data. In absence of manufacturer's published data, use NETA ATS Table 100.12.
    g. Inspect operating mechanism, contacts, and chutes in unsealed units.
    h. Perform adjustments for final protective device settings in accordance with coordination study.
2. Electrical Tests:
    a. Perform resistance measurements through bolted connections with low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.

b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In absence of manufacturer's published data, use Table 100.1 from NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
c. Perform contact/pole resistance test. Drop values may not exceed high level of manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.
d. Perform insulation resistance tests on control wiring with respect to ground. Applied potential must be 500 V(dc) for 300 V rated cable and 1000 V(dc) for 600 V rated cable. Test duration must be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values may be no less than 2 M Ω.
e. Determine the following by primary current injection:
    1) Long-time pickup and delay. Pickup values must be as specified. Trip characteristics may not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
    2) Short-time pickup and delay. Short-time pickup values must be as specified. Trip characteristics may not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
    3) Ground-fault pickup and time delay. Ground-fault pickup values must be as specified. Trip characteristics may not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
    4) Instantaneous pickup. Instantaneous pickup values must be as specified and within manufacturer's published tolerances.
f. Test functionality of trip unit by means of primary current injection. Pickup values and trip characteristics must be as specified and within manufacturer's published tolerances.
g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of shunt trip and close coils must be as indicated by manufacturer.
h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset trip logs and indicators. Investigate units that do not function as designed.
i. Verify operation of charging mechanism. Investigate units that do not function as designed.

3. Test and adjust controls, remote monitoring, and safeties.

C. Nonconforming Work:
1. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
2. Remove and replace defective units and retest.

D. Collect, assemble, and submit test and inspection reports.
1. Test procedures used.

2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
3. List deficiencies detected, remedial action taken, and observations after remedial action.

E. Manufacturer Services:
1. Engage factory-authorized service representative to support field tests and inspections.

3.6 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Coordination Studies."

3.7 PROTECTION

A. After installation, protect enclosed switches and circuit breakers from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION

SECTION 264313 – SURGE PROTECTIVE DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Type 2 surge protective devices (SPDs).
2. Enclosures.
3. Conductors and cables.

B. Related Requirements:
1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 262413 "Switchboards" for integral SPDs installed by switchboard manufacturer.
3. Section 262416 "Panelboards" for integral SPDs installed by panelboard manufacturer.
4. Section 262726 "Wiring Devices" for integral SPDs installed by receptacle manufacturer.

1.2 DEFINITIONS

A. I_n: Nominal discharge current.

B. Maximum Continuous Operating Voltage (MCOV): The maximum designated RMS value of the power frequency voltage that may be continuously applied to the mode of protection of an SPD.

C. Metal-Oxide Varistor (MOV): An electronic component with a significant bidirectional, nonlinear current-voltage characteristic.

D. Mode(s), Modes of Protection, or Protection Modes: Electrical paths where the SPD offers defense against transient overvoltage's. Examples include line to neutral (L-N), line to ground (L-G), line to line (L-L), and neutral to ground (N-G).

E. SCCR: Short-circuit current rating.

F. Type 2 SPDs: Permanently connected SPDs intended for installation on the load side of the service disconnect overcurrent device, including SPDs located at the branch panel.

G. Voltage Protection Rating (VPR): A rating selected from UL 1449 list of preferred values assigned to each mode of protection.

1.3 ACTION SUBMITTALS

A. Product Data:
   1. For each type of product.
      a. Include electrical characteristics, specialties, and accessories for SPDs.
      b. Certification of compliance with UL 1449 by qualified electrical testing laboratory recognized by authorities having jurisdiction including the following information:
         1) Tested values for VPRs.
         2) I_n ratings.
         3) MCOV, type designations.
         4) OCPD requirements.
         5) Manufacturer's model number.
         6) System voltage.
         7) Modes of protection.

B. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For manufacturer's special warranty.

PART 2 - PRODUCTS

2.1 TYPE 2 SURGE PROTECTIVE DEVICES (SPDs)

A. Source Limitations: Obtain devices from single source from single manufacturer.

B. General Characteristics:
   1. Reference Standards: UL 1449, Type 2; UL 1283.
   2. MCOV: Not less than 125 percent of nominal system voltage for 208Y/120 V and 120/240 V power systems, and not less than 115 percent of nominal system voltage for 480Y/277 V power systems.
   3. Peak Surge Current Rating: Minimum single-pulse surge current withstand rating per phase must not be less than 100 kA. Peak surge current rating must be arithmetic sum of the ratings of individual MOVs in a given mode.
   4. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V or208Y/120 V, three-phase, four-wire circuits must not exceed the following:
      a. Line to Neutral: 1200 V for 480Y/277 V , 700 V for 208Y/120 V.
      b. Line to Ground: 1200 V for 480Y/277 V , 700 V for 208Y/120 V.
      c. Neutral to Ground: 1200 V for 480Y/277 V , 700 V for 208Y/120 V.
      d. Line to Line: 2000 V for 480Y/277 V , 1200 V for 208Y/120 V.
   5. Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits must not exceed the following:
      a. Line to Neutral: 700 V.
      b. Line to Ground: 700 V.
      c. Neutral to Ground: 700 V.
      d. Line to Line: 1200 V.
   6. SCCR: Equal or exceed 100 kA.

7. I_n Rating: 20 kA.

C. Options:
1. Include LED indicator lights for power and protection status.
2. Include internal thermal protection that disconnects the SPD before damaging internal suppressor components.
3. Include NEMA ICS 5, dry Form C contacts rated at 2 A and 24 V(ac) for remote monitoring of protection status.
4. Include surge counter.

2.2 ENCLOSURES

A. Indoor Enclosures: Type 1.

B. Outdoor Enclosures: Type 3R.

2.3 CONDUCTORS AND CABLES

A. Power Wiring: Same size as SPD leads, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide OCPD and disconnect for installation of SPD in accordance with UL 1449 and manufacturer's instructions.

B. Install leads between disconnects and SPDs short, straight, twisted, and in accordance with manufacturer's instructions. Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
1. Do not splice and extend SPD leads unless specifically permitted by manufacturer.
2. Do not exceed manufacturer's recommended lead length.
3. Do not bond neutral and ground.

C. Use crimped connectors and splices only. Wire nuts are unacceptable.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:
1. Compare equipment nameplate data for compliance with Drawings and the Specifications.
2. Inspect anchorage, alignment, grounding, and clearances.
3. Verify that electrical wiring installation complies with manufacturer's installation requirements.

B. Nonconforming Work:
   1. SPDs that do not pass tests and inspections will be considered defective.
   2. Remove and replace defective units and retest.

C. Prepare test and inspection reports.

D. Manufacturer Services:
   1. Engage factory-authorized service representative to support field tests and inspections.

3.3 STARTUP SERVICE

A. Complete startup checks in accordance with manufacturer's instructions.

B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests; reconnect them immediately after the testing is over.

C. Energize SPDs after power system has been energized, stabilized, and tested.

END OF SECTION

SECTION 265000 – LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Luminaires.
2. Luminaire fittings.

B. Related Requirements:
1. Section 260010 "Supplemental Requirements for Electrical" specifies additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260529 "Hangers and Supports for Electrical Systems" specifies channel and angle supports installed by this Section.
3. Section 260553 "Identification for Electrical Systems" specifies electrical equipment labels and warning signs installed by this Section.
4. Section 260943.16 "Network Lighting Controls" specify manual or programmable control systems with low-voltage control wiring or data communication circuits installed by this Section.

1.2 DEFINITIONS

A. BUG Rating: Backlight, upplight, and glare rating for light pollution from exterior luminaires.

B. Correlated Color Temperature (CCT): The absolute temperature (in kelvins) of a blackbody whose chromaticity (color quality) most nearly resembles that of the light source.

C. Color Rendering Index (CRI): The measure of the degree of color shift objects undergo when illuminated by the light source as compared with the color of those same objects when illuminated by a reference light source. The lower the CRI of a light source, the more difficult it is to identify colors and stripes on electronic components and wiring.

1.3 ACTION SUBMITTALS

A. Product Data:
1. For luminaires.
a. Product Listing: Include copy of unexpired approval letter, on letterhead of qualified electrical testing agency, certifying product's compliance with specified listing criteria.
1) If listed manufacturer differs from selling manufacturer, indicate relationship between entities on submittal. Clearly indicate which entity warrants product performance and fitness for purpose.

2) Listing criteria identified in approval letter must match specified listing criteria. Approval of only equipment's enclosure is not considered approval of equipment for intended application.
3) Product identification in approval letter must match product branding and model numbers in submittal. Approval letters for similar products are not acceptable.

b. Product Certificates: Include product certificates stating compliance with standards listed below, signed by manufacturer or fabricator.
1) Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with current accreditation under National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.
2) Testing Agency Certified Data: For luminaires indicated on Lighting Fixture Schedule on Drawings, photometric data certified by qualified independent testing laboratory. Photometric data for remaining luminaires must be certified by manufacturer.

c. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
d. Include operating characteristics, electrical characteristics, and furnished accessories.
e. Include schedule of submitted lighting products. Arrange schedule and accompanying product data in order by luminaire and lamp designations indicated on Drawings.
f. Include battery and charger data for emergency lighting units.
g. Include ballast factor.
h. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
i. Include photometric data and adjustment factors obtained from qualified laboratory tests.
j. Include manufacturer's sample warranty language.

2. For luminaire fittings.
a. Product Listing: Include copy of unexpired approval letter, on letterhead of qualified electrical testing agency, certifying product's compliance with specified listing criteria.
1) If listed manufacturer differs from selling manufacturer, indicate relationship between entities on submittal. Clearly indicate which entity warrants product performance and fitness for purpose.
2) Listing criteria identified in approval letter must match specified listing criteria. Approval of only equipment's enclosure is not considered approval of equipment for intended application.
3) Product identification in approval letter must match product branding and model numbers in submittal. Approval letters for similar products are not acceptable.

b. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
c. Include operating characteristics, electrical characteristics, and furnished accessories.
d. Include schedule of submitted lighting products. Arrange schedule and accompanying product data in order by luminaire and lamp designations indicated on Drawings.
e. Include manufacturer's sample warranty language.

B. Sustainable Design Product Data:
   1. For luminaires.
      a. Energy Efficiency: Submit product certificate indicating luminaire is certified by Energy Star.
      b. Energy Usage: Submit product data showing compliance with ASHRAE 90.1.
      c. BUG Ratings: Submit product data indicating BUG ratings of all installed exterior luminaires.
      d. Luminaire Calculations: Submit product data indicating lumen emittance and vertical illuminance.
      e. Environmental Product Declaration: For each product.
      f. Health Product Declaration: For each product.
      g. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
      h. Third-Party Certifications: For each product.
      i. Third-Party Certified Life Cycle Assessment: For each product.
   2. For luminaire fittings.
      a. Environmental Product Declaration: For each product.
      b. Health Product Declaration: For each product.
      c. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
      d. Third-Party Certifications: For each product.
      e. Third-Party Certified Life Cycle Assessment: For each product.

C. Shop drawings.

D. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturers' published instructions.

B. Field Reports:
   1. Manufacturer's field reports for field quality-control support.
   2. Manufacturer's field reports for system startup support.

1.5 CLOSEOUT SUBMITTALS

A. Warranty documentation.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect exposed surface finishes on lighting equipment by applying strippable, temporary protective covering before shipping.

PART 2 - PRODUCTS

2.1 LUMINAIRES

A. Performance Criteria:
1. Regulatory Requirements:
a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
b. See individual product types below for listing criteria.
c. Marked in accordance with UL CCN HYXT, including UL 1598, for compatible power supply, installation location, and environmental conditions.

B. Source Quality Control:
1. Compile and submit product data.
2. Compile and submit sustainable design product data.
3. Compile and submit samples.

C. Luminaires: refer to luminaire fixture schedule in drawings.
1. Source Limitations: Obtain products for this luminaire type from single manufacturer.
2. Product Listing Criteria, LED: UL CCN IFAM; including UL 1598.
3. Product Listing Criteria, CMH HID: UL CCN IEXT; including UL 1598.
4. Product Listing Criteria, Outdoor Canopy Luminaires: UL CCN IFAW; including UL 1598.
5. Product Characteristics:
a. Openings: Doors, frames, and access panels must operate smoothly, not leak light under operating conditions, and permit re-lamping without use of tools or parts falling from enclosure.
b. Nominal Operating Voltage: per luminaire fixture schedule.
c. Nominal Luminaire Operating Power Rating: per luminaire fixture schedule.
d. CRI: per luminaire fixture schedule.
e. Ballast or Driver Location: luminaire fixture schedule.
f. Materials:
1) Enclosure: refer to luminaire fixture schedule for requirements on housing and heat sink; must be free of sharp edges and burrs.
2) Enclosure Ingress Protection Rating: refer to luminaire fixture schedule.
3) Lenses, Diffusers, and Globes: refer to luminaire fixture schedule.
4) Visible variations in metal finishes outside range of approved Samples are unacceptable in adjoining components.
g. LED Luminaires (UL CCN IFAM): refer to luminaire fixture schedule.
6. Required Product Options:
a. Mounting Hardware: refer to luminaire fixture schedule.
b. Mounting Height: refer to luminaire fixture schedule and drawings.
c. Decorative Post Top: refer to luminaire fixture schedule.
d. Roadway Pole: refer to luminaire fixture schedule.
e. Finishes:
1) Enclosure: refer to luminaire fixture schedule for finish.
2) Reflector: refer to luminaire fixture schedule.

3) Reflecting surfaces must have minimum reflectance as follows, unless otherwise indicated:
   a) White Surfaces: 85 percent.
   b) Specular Surfaces: 83 percent.
   c) Diffusing Specular Surfaces: 75 percent.

f. Visible variations in metal finishes outside range of approved Samples are unacceptable in adjoining components.
g. Dimmable from 100 percent to zero percent of maximum light output.
h. EMI Filters: Factory installed to suppress conducted EMI in accordance with MIL-STD-461E. Fabricate luminaires with one filter on each ballast requiring filter.
i. Stainless steel latches.
j. Integral pressure equalizer.
k. Photoelectric Switch: Factory-mounted integral to luminaire; listed and labeled in accordance with UL CCN WJFX, including UL 773, or in accordance with UL CCN WJCT, including UL 773A.
   1) Contact Relays: Factory mounted, single throw, designed to fail in on position, and factory set to turn light unit on at 1.5 to 3 fc (15 to 30 lx) and off at 4.5 to 10 fc (45 to 100 lx) with 15 s minimum time delay.
      a) Relay with locking-type receptacle must comply with NEMA C136.10.
      b) Adjustable window slide for adjusting on-off set points.
l. In-line Fusing: Separate in-line fuse for each luminaire.

D. UL FWBO - Exit Fixture: refer to luminaire fixture schedule.

2.2 LUMINAIRE FITTINGS

A. Performance Criteria:
   1. Regulatory Requirements:
      a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
      b. See individual product types below for listing criteria.

B. Source Quality Control:
   1. Compile and submit product data.
   2. Compile and submit sustainable design product data.
   3. Compile and submit samples.

C. Luminaire Support Accessories:
   1. Product Characteristics:
      a. Sized and rated for luminaire weight.
      b. Capable of maintaining luminaire position after cleaning and re-lamping.
      c. Capable of supporting luminaire without causing deflection of ceiling or wall.
      d. Capable of supporting horizontal force equal to 100 percent of luminaire weight and vertical force equal to 400 percent of luminaire weight.
   2. Required Product Options:

a. Hook Hangers: Integrated assembly matched to luminaire, supply voltage, and equipment with threaded attachment, cord, and locking-type plug.
b. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm) wire supports.
c. Aircraft Cables: 5/32 inch (4 mm) diameter aircraft cable supports.
d. Single-Stem Hangers: 1/2 inch (13 mm) nominal diameter steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
e. Rod Hangers: 3/16 inch (5 mm) nominal diameter, cadmium-plated, threaded steel rod.

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 luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Shop Drawings: Prepare and submit the following:
1. Drawings, Diagrams, and Supporting Documents for Custom Luminaires:
a. Include plans, elevations, sections, and mounting and attachment details.
b. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
c. Include diagrams for power, signal, and control wiring.

B. Temporary Lighting: If approved by Architect, specified luminaires for Project may be installed for temporary lighting. Install and energize minimum quantity of luminaires necessary to meet needs of construction activities. When construction is sufficiently complete, remove, disassemble, clean, and re-lamp luminaires used for temporary lighting before reinstalling for Project delivery.

3.3 INSTALLATION OF LIGHTING

A. Comply with manufacturer's published instructions.

B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:
1. Installation of Indoor Lighting Systems: NECA NEIS 500.
2. Installation of Exterior Lighting Systems: NECA NEIS 501.

3. Installation of Industrial Lighting Systems: NECA NEIS 502.
4. Installation of Luminaires, Lampholders, and Lamps: Article 410 of NFPA 70.
5. Installation of Extra-Low-Voltage Lighting: Article 411 of NFPA 70.
6. Installation of Lighting for Sensitive Electronic Equipment: Article 647 of NFPA 70.
7. Installation of Emergency Lighting and Exit Signs: ICC IBC, NFPA 101, and Parts IV and V in Article 700 of NFPA 70.
8. Consult Architect for resolution of conflicting requirements.

C. Special Installation Techniques:
1. Install luminaires level, plumb, and square with finished floor or grade unless otherwise indicated.
2. Install luminaires at height and aiming angle as indicated on Drawings.
3. Coordinate layout and installation of luminaires with other construction.
4. Adjust luminaires that require field adjustment or aiming.
5. Exterior Corrosion Prevention:
    a. Do not use aluminum in contact with earth or concrete. When in direct contact with dissimilar metals, protect aluminum with insulating fittings or treatment.
    b. When embedding steel conduits in concrete, wrap conduit with 10 mil (0.254 mm) thick, pipe-wrapping plastic tape applied with a 50 percent overlap.
6. Flush-Mounted Luminaire Support:
    a. Secured to outlet box.
    b. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
    c. Trim ring flush with finished surface.
7. Wall-Mounted Luminaire Support:
    a. Attached to structural members in walls.
    b. Do not attach luminaires directly to gypsum board.
8. Suspended Luminaire Support:
    a. Ceiling Mount:
        1) Hook hangers.
        2) Four wires.
        3) Four aircraft cables.
    b. Pendants and Rods: Where longer than 48 inch (1220 mm), brace to limit swinging.
    c. 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.
    d. Continuous Rows of Luminaires: Provide tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
    e. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
9. Ceiling-Grid-Mounted Luminaire Support:
    a. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each luminaire. Locate not more than 6 inch (150 mm) from luminaire corners.
    b. Support Clips: Fasten to luminaires and to ceiling grid members at or near each luminaire corner with clips that are UL listed for application.

c. Luminaires of Sizes Smaller Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support luminaires independently with no fewer than two 3/4 inch (20 mm) metal channels spanning and secured to ceiling tees.
d. Seismic Restraint: Install at least one independent support rod or wire from structure to tab on luminaire. Wire or rod must have breaking strength for luminaire weight with safety factor of 3.

10. Remote Mounting of Ballasts: Do not exceed distance between ballast and luminaire recommended by ballast manufacturer.
11. Emergency Power Units: Secure with approved fasteners in four or more locations, spaced near corners of unit.
12. Install wiring connections for luminaires.
13. Identification: Provide labels for luminaires and associated electrical equipment.
    a. Identify field-installed conductors, interconnecting wiring, and components.
    b. Provide warning signs.
    c. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL OF LIGHTING

A. Tests and Inspections:
1. Perform manufacturer's recommended tests and inspections.
2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
3. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
4. Verify operation of photoelectric controls.
5. Exterior Illumination Tests:
    a. Measure light intensities at night. Use photometers with calibration referenced to NIST standards.

B. Nonconforming Work:
1. Luminaire will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

C. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.

3.5 SYSTEM STARTUP

A. Perform startup service.
1. Complete installation and startup checks in accordance with manufacturer's published instructions.

3.6 PROTECTION

A. After installation, protect lighting equipment from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION

SECTION 265213 – EMERGENCY AND EXIT LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Emergency lighting.
2. Exit signs.
3. Materials.
4. Luminaire support components.

B. Related Requirements:
1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data:
1. For each type of emergency lighting unit, exit sign, and emergency lighting support.
a. Include data on features, accessories, and finishes.
b. Include physical description of unit and dimensions.
c. Battery and charger for light units.
d. Include life, output of luminaire (lumens, CCT, and CRI), and energy-efficiency data.
e. Include photometric data and adjustment factors based on laboratory tests by, or under supervision of, qualified luminaire photometric testing laboratory, for each luminaire type.

B. Shop Drawings:
1. For nonstandard or custom luminaires.
a. Include plans, elevations, sections, and mounting and attachment details.
b. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
c. Include diagrams for power, signal, and control wiring.

C. Product Schedule:
1. For emergency lighting units. Use same designations indicated on Drawings.
2. For exit signs. Use same designations indicated on Drawings.

1.3 QUALITY ASSURANCE

A. FM Global Compliance: Luminaires for hazardous locations must be listed and labeled for indicated class and division of hazard by FM Global.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.5 WARRANTY

A. Special Installer Extended Warranty for Emergency and Exit Lighting: Installer warrants that fabricated and installed emergency luminaires and exit signs, including batteries, perform in accordance with specified requirements and agrees to repair or replace components and assemblies that fail to perform as specified within extended warranty period.
   1. Extended Warranty Period: One year(s) from date of Substantial Completion; full coverage for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

A. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70 and UL 924, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

B. Comply with NFPA 101.

C. Comply with NEMA LE 4 for recessed luminaires.

2.2 EXIT SIGNS

A. General Characteristics: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Sign:
   1. Options:
      a. Operating at nominal voltage per luminaire schedule on drawings.
      b. Lamps for AC Operation: LEDs; 50,000 hours minimum rated lamp life.
      c. Self-Powered Exit Signs (Battery Type): Internal emergency power unit.

C. Self-Luminous Sign:
   1. Options:
      a. Powered by tritium gas, with universal bracket for flush-ceiling, wall, or end mounting. Signs must be guaranteed by manufacturer to maintain minimum brightness requirements in UL 924 for 10 years.
      b. Use strontium oxide aluminate compound to store ambient light and release stored energy when light is removed. Include universal bracket for flush-ceiling, wall, or end mounting.

2.3 METAL FINISHES

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 range of approved Samples and are assembled or installed to minimize contrast.

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.

B. Support Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 0.106 inch (2.69 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for conditions affecting performance of luminaires.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Examine walls, floors, roofs, and ceilings for suitable conditions where emergency lighting luminaires will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

B. Install lamps in each luminaire.

C. 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.
4. Luminaire-mounting devices must be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of luminaire weight.

D. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.
2. Do not attach luminaires directly to gypsum board.

E. Suspended Luminaire Support:
1. Pendants and Rods: Where longer than 48 inch (1200 mm), 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 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.

F. Ceiling Grid Mounted Luminaires:
1. Secure to outlet box, if provided.
2. Secure emergency power unit using approved fasteners in a minimum of four locations, spaced near corners of emergency power unit.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

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. 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. Nonconforming Work:
1. Luminaire will be considered defective if it does not pass operation tests and inspections.
2. Remove and replace defective units and retest.

C. Prepare test and inspection reports.

3.5 PROTECTION

A. Remove and replace luminaires and exit signs that are damaged or caused to be unfit for use by construction activities.

END OF SECTION

SECTION 265613 – LIGHTING POLES AND STANDARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Steel poles.
   2. Pole accessories.
   3. Mounting hardware.

B. Related Requirements:
   1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 DEFINITIONS

A. EPA: Equivalent projected area.

B. Pole: Luminaire-supporting structure, including tower used for large-area illumination.

C. Standard: See "Pole."

1.3 ACTION SUBMITTALS

A. Product Data:
   1. Steel poles.
   2. Mounting hardware.

B. Shop Drawings:
   1. Include plans, elevations, sections, and mounting 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 poles.
   4. Anchor bolt templates keyed to specific poles and certified by manufacturer.
   5. Method and procedure of pole installation. Include manufacturer's written installations.

C. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

A. Material Test Reports:
   1. For each foundation component, by qualified testing laboratory.

2. For each pole, by qualified testing laboratory.

B. Soil test reports.

C. Manufacturers' published instructions.

D. Field Reports:
1. Manufacturer's field reports for field quality-control support.

1.5 CLOSEOUT SUBMITTALS

A. Warranty documentation.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Spare Parts and Special Tools: Furnish to Owner spare parts, proprietary equipment, and keys required to operate, maintain, repair, adjust, or implement future changes to poles, that are packaged with protective covering for storage on-site and identified with labels describing contents.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store poles on decay-resistant skids at least 12 inch (300 mm) above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

B. Retain factory-applied pole wrappings on metal poles until right before pole installation. Handle poles with web fabric straps.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Characteristics: Comply with AASHTO LTS-6-M.

B. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied in accordance with AASHTO LTS-6-M.

C. Live Load: Single load of 500 lb (2200 N) distributed in accordance with AASHTO LTS-6-M.

D. Ice Load: Load of 3 lb/ft^2 (145 Pa), applied in accordance with AASHTO LTS-6-M for applicable areas on the Ice Load Map.

E. Wind Load for Poles Not Exceeding 50 ft (15 m) Height:
1. Basic Wind Speed: 100 mile/h (45 m/s).
2. Wind Importance Factor: 1.0.

3. Minimum Design Life: 50 years.
4. Velocity Conversion Factor: 1.0.

F. Strength Analysis: For each pole, multiply the actual EPA of luminaires and brackets by a factor of 1.1 to obtain the EPA used in pole selection strength analysis.

G. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless steel fasteners and mounting bolts unless otherwise indicated.

H. General Finish Requirements:
1. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
2. 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.

2.2 STEEL POLES

A. Source Limitations: Obtain poles from single manufacturer or producer.

B. Carbon-Steel Poles: Comply with ASTM A500/A500M, Grade B carbon steel with a minimum yield of 46,000 psig (317 MPa); one-piece construction up to 40 ft (12 m) in height with access handhole in pole wall.
1. Shape: as indicated on luminaire schedule.
2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

C. Brackets for Luminaires: Detachable, cantilever, without underbrace.
1. Adaptor fitting welded to pole, allowing the bracket to be bolted to the pole-mounted adapter, then bolted together with galvanized-steel bolts.
2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire. Match pole material and finish.

D. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

E. Fasteners: Galvanized steel, size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.
1. Materials: Compatible with poles and standards as well as the substrates to which poles and standards are fastened and may not cause galvanic action at contact points.
2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.

F. Grounding and Bonding Lugs: Welded 1/2 inch (13 mm) threaded lug, complying with requirements in Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size indicated, and accessible through handhole.

G. Steps: Fixed steel, with nonslip treads.
   1. For climbing positions, install at 15 inch (381 mm) vertical spacing, alternating on opposite sides of pole, oriented 180 degrees from each other; first step must be at an elevation 10 ft (3 m) above finished grade.
   2. For working positions, install steps on opposite side of pole, oriented 180 degrees from each other at the same elevation.

H. Handhole: Oval shaped, with minimum clear opening of 2-1/2-by-5 inch (65-by-130 mm), with cover secured by stainless steel captive screws.

I. Intermediate Handhole and Cable Support: Weatherproof, 3-by-5 inch (76-by-130 mm) handhole located at midpoint of pole, with cover for access to internal welded attachment lug for electric cable support grip.

J. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported load multiplied by a 5.0 safety factor.

K. Platform for Lamp Ballast Servicing: Factory fabricated of steel, with finish matching that of pole.

L. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.

M. Galvanized Finish: After fabrication, hot-dip galvanize in accordance with ASTM A123/A123M.

N. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
   1. Surface Preparation: Clean surfaces in accordance with SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, in accordance with SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
   2. Interior Surfaces of Pole: One coat of bituminous paint, or otherwise treat for equal corrosion protection.
   3. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high gloss, high-build polyurethane enamel.
      a. Color: as indicated on luminaire schedule.

2.3 MOUNTING HARDWARE

A. Anchor Bolts: Manufactured to ASTM F1554, Grade 55, with a minimum yield strength of 55,000 psi (380 000 kPa).

B. Nuts: ASTM A563, Grade A, Heavy-Hex.

C. Washers: ASTM F436, Type 1.

2.4 SOURCE QUALITY CONTROL

A. Product Data: Prepare and submit catalog cuts, brochures, and performance data illustrating size, physical appearance, and other characteristics of product.
   1. Include data on construction details, profiles, EPA, cable entrances, materials, dimensions, weight, rated design load, and ultimate strength of individual components.
   2. Include finishes for lighting poles and luminaire-supporting devices.
   3. Anchor bolts.
   4. Manufactured pole foundations.
   5. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in accordance with AASHTO LTS-6-M and that load imposed by luminaire and attachments has been included in design. The certification must be based on design calculations signed and sealed by a professional engineer.
   6. Include sample warranty language.

B. Manufacturer's Published Instructions: Prepare and submit installation, testing, and operating instructions for product.

C. Samples: Submit finish samples for each exposed lighting pole, standard, and luminaire-supporting device and for each color and texture specified.

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 poles, luminaire-mounting devices, lowering devices, and pole accessories before installation. Components that are scratched, dented, marred, wet, moisture damaged, or visibly damaged are considered defective.

C. Examine roughing-in for foundation and conduit to verify actual locations of installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 POLE FOUNDATION

A. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Structural steel complying with ASTM A36/A36M and hot-dip galvanized in accordance with ASTM A123/A123M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."

B. Anchor Bolts: Install plumb using manufacturer-supplied template, uniformly spaced.

3.3 POLE INSTALLATION

A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on pole.

B. Concrete Pole Foundations: Set anchor bolts in accordance with anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Section 033000 "Cast-in-Place Concrete."

3.4 CORROSION PREVENTION

A. Steel Conduits: Comply with requirements in Section 260533.13 "Conduits for Electrical Systems." In concrete foundations, wrap conduit with 0.010 inch (0.254 mm) thick, pipe-wrapping plastic tape applied with a 50-percent overlap.

3.5 GROUNDING

A. Ground Metal Poles and Support Structures: Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
   1. Install grounding electrode for each pole unless otherwise indicated.
   2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

3.6 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.7 FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. Inspect poles for nicks, mars, dents, scratches, and other damage.
   2. System function tests.

B. Nonconforming Work:
   1. Unit will be considered defective if they do not pass tests and inspections.
   2. Remove and replace defective units and retest.

C. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.

END OF SECTION

SECTION 265619 – LED EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Luminaire-mounted photoelectric relays.
2. Materials.
3. Finishes.
4. Luminaire support components.

B. Related Requirements:
1. Section 260943.16 "Network Lighting Controls" for manual or programmable control systems with low-voltage control wiring or data communication circuits.
2. Section 265613 "Lighting Poles and Standards" for poles and standards used to support exterior lighting equipment.

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.
1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaire.
4. Lamps include life, output (lumens, CCT, and CRI), and energy-efficiency data.
5. Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project.
a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.

b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

6. Wiring diagrams for power, control, and signal wiring.
7. Photoelectric relays.
8. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.

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. Delegated Design Submittals: For luminaire supports.
1. Include design calculations for luminaire supports and seismic restraints.

1.4 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. Luminaires.
2. Structural members to which equipment and luminaires will be attached.
3. Underground utilities and structures.
4. Existing underground utilities and structures.
5. Above-grade utilities and structures.
6. Existing above-grade utilities and structures.
7. Building features.
8. Vertical and horizontal information.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Seismic Qualification Data: For luminaires, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Product Certificates: For each type of the following:
1. Luminaire.
2. Photoelectric relay.

E. Product Test Reports: For each luminaire, for tests performed by a qualified testing agency.

F. Source quality-control reports.

G. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and photoelectric relays to include in operation and maintenance manuals.
   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 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications:
   1. Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
   2. Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products and complying with applicable IES testing standards.

B. Provide luminaires from a single manufacturer for each luminaire type.

C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

D. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.8 FIELD CONDITIONS

A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.

B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.9 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. Failures include, but are not limited to, the following:

a. Structural failures, including luminaire support components.
b. Faulty operation of luminaires and accessories.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Period: 2 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance:
1. Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
2. Luminaires and lamps shall be labeled vibration and shock resistant.
3. 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. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

D. UL Compliance: Comply with UL 1598 and listed for wet location.

E. Lamp base complying with ANSI C81.61 or IEC 60061-1.

F. Bulb shape complying with ANSI C79.1.

G. CRI of minimum 80. CCT per luminaire schedule.

H. L70 lamp life of 50,000 hours.

I. Lamps dimmable from 100 percent to 0 percent of maximum light output.

J. Internal driver.

K. Nominal Operating Voltage: per luminaire schedule

L. In-line Fusing: On the primary for each luminaire.

M. Lamp Rating: Lamp marked for outdoor use and in enclosed locations.

N. Source Limitations:
1. Obtain luminaires from single source from a single manufacturer.
2. 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 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

A. Comply with UL 773 or UL 773A.

B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc (16 to 32 lx) and off at 4.5 to 10 fc (48 to 108 lx) with 15-second minimum time delay.
1. Relay with locking-type receptacle shall comply with ANSI C136.10.
2. Adjustable window slide for adjusting on-off set points.

2.4 MATERIALS

A. Metal Parts: Free of burrs and sharp corners and edges.

B. Sheet Metal Components: Epoxy-coated steel. 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 (3.175 mm) 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.

H. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
   1. Label shall include the following lamp characteristics:
      a. "USE ONLY" and include specific lamp type.
      b. Lamp diameter, shape, size, wattage, and coating.
      c. CCT and CRI for all luminaires.

2.5 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.
   3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
   4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.
      a. Color: per luminaire schedule.

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. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
   2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
      a. Color:
         1) As selected from manufacturer's standard catalog of colors.
         2) Match Architect's sample of manufacturer's standard color.
         3) As selected by Architect from manufacturer's full range.

2.6 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 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 luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.

C. Examine walls, roofs, and canopy ceilings and overhang ceilings for suitable conditions where luminaires will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

A. If approved by Architect, use selected permanent luminaires for temporary lighting. When construction is substantially complete, clean luminaires used for temporary lighting and install new lamps.

3.3 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 level, plumb, and square with finished grade unless otherwise indicated.

I. Coordinate layout and installation of luminaires with other construction.

J. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533.13 "Conduits for Electrical Systems" for wiring connections and wiring methods.

3.4 INSTALLATION OF INDIVIDUAL GROUND-MOUNTED LUMINAIRES

A. Aim as indicated on Drawings.

B. Install on concrete base with top 4 inches (100 mm) above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 033000 "Cast-in-Place Concrete."

3.5 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Section 260533.13 "Conduits for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- (0.254-mm-) thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.6 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.7 FIELD QUALITY CONTROL

A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

B. 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. Photoelectric Control Operation: 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 the lighting system, retest to demonstrate compliance with standards.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain luminaires and photocell relays.

END OF SECTION

SECTION 271300 - COMMUNICATIONS BACKBONE CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general conditions, Division 1, and Basic Electrical Requirements (Section 26 05 00) are part of this section and the contract for this work and apply to this section as fully as if repeated herein.

B. Reference to other sections: The applicable requirements from other Division 26 sections required for a complete and operational system shall form a part of the electrical work and each section shall be thoroughly reviewed by the Contractor for application to all other sections.

1.2 SCOPE

A. Section Includes:

1. Pathways.
2. UTP cable.
3. 8/125-micrometer, singlemode optical fiber cabling.
4. 50/125-micrometer, multimode optical fiber cabling.
5. Cable connecting hardware, patch panels, and cross-connects.
6. Cabling identification products.

1.3 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. Cross-Connect: A facility enabling the termination of cable elements and their inter-connection or cross-connection.

C. EMI: Electromagnetic interference.

D. IDC: Insulation displacement connector.

E. LAN: Local area network.

F. OFL: Over filled launch

G. RCDD: Registered Communications Distribution Designer.

H. UTP: Unshielded twisted pair.

1.4 BACKBONE CABLING DESCRIPTION

A. Backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.

B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

1.5 PERFORMANCE REQUIREMENTS

A. General Performance: Backbone cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

1.6 SUBMITTALS

A. Product Data: For each type of product indicated.

1. For coaxial cable, include the following installation data for each type used:

    a. Nominal OD.
    b. Minimum bending radius.
    c. Maximum pulling tension.

B. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
3. Cabling administration drawings and printouts.
4. Wiring diagrams to show typical wiring schematics including the following:

    a. Cross-connects.
    b. Patch panels.
    c. Patch cords.

5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
6. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:

    a. Vertical and horizontal offsets and transitions.
    b. Clearances for access above and to side of cable trays.
    c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.

d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.

C. Qualification Data: For installer, qualified layout technician, installation supervisor, and field inspector.

D. Source quality-control reports.

E. Field quality-control reports.

F. Maintenance Data: For splices and connectors to include in maintenance manuals.

G. 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. Device address list.
4. Printout of software application and graphic screens.

1.7 QUALITY ASSURANCE AND STANDARDS

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings, and field testing program development by an RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

B. Testing Agency Qualifications: An NRTL.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

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.

E. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.

F. Grounding: Comply with ANSI-J-STD-607-A.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical fiber flashlight.
2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.
3. Test each pair of UTP cable for open and short circuits.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.10 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

1.11 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 operating system. 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.

1.12 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. UTP Patch-panel units: Four (4) of each type.
2. Optical fiber connector panels: Two (2) of each type

PART 2 - PRODUCTS

2.1 PATHWAYS

A. General Requirements: Comply with TIA/EIA-569-A.

B. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.

1. Support brackets with cable tie slots for fastening cable ties to brackets.
2. Lacing bars, spools, J-hooks, and D-rings.
3. Straps and other devices.

C. Cable Trays:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Cablofil Inc.
b. Cooper B-Line, Inc.
c. Cope - Tyco/Allied Tube & Conduit.
d. PW Industries.

2. Cable Tray Material: Metal, suitable for indoors, and protected against corrosion by electroplated zinc galvanizing, complying with ASTM B 633, Type 1, not less than 0.000472 inches thick.

a. Ladder Cable Trays: Nominally 12 inches wide, and a rung spacing of 9 inches.

D. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceways" and "Boxes."

1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high and 2-1/2 inches deep.

2.2 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements in Division 6 Section "Rough Carpentry" for plywood backing panels.

2.3 UTP CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by the following manufacturer:

1. Berk Tek Leviton Solutions

B. Description: 100-ohm, 4-pair UTP, with a gray thermoplastic jacket.

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-B.1 for performance specifications.
3. Comply with TIA/EIA-568-B.2, Category 6.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

a. Communications, General Purpose: Type CM or CMG.
b. Communications, Plenum Rated: Type CMP, complying with NFPA 262.

2.4 UTP CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by the following manufacturer:

1. Berk Tek Leviton Solution.

B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

C. Connecting Blocks: 110-style IDC for Category 6. Provide blocks for the number of cables terminated on the block, plus 10 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.

1. Number of Terminals per Field: One for each conductor in assigned cables.

E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.

1. Number of Jacks per Field: One for each four-pair UTP cable indicated.

F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

G. Patch Cords: Factory-made, 4-pair cables in 72-inch and 120-inch lengths; terminated with 8-position modular plug at each end.

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.

2. Patch cords shall have color-coded boots for circuit identification.

2.5 OPTICAL FIBER CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturer:

1. Corning Incorporated.

B. Description: Multimode 50/125-micrometer (12-fiber), multimode 62.5/125-micrometer (12-fiber), singlemode 8/125-micrometer (12-fiber) nonconductive, tight buffer, optical fiber cable.

1. Comply with ICEA S-83-596 for mechanical properties.
2. Comply with TIA/EIA-568-B.3 for performance specifications.
3. Comply with TIA/EIA-492AAAA-B for detailed specifications.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:

a. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.

5. Multimode 50/125-micrometer performance:

a. Maximum Attenuation: 3.0 dB/km at 850 nm; 1.0 dB/km at 1300 nm.
b. Minimum OFL Bandwidth: 700 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

6. Singlemode 8/125-micrometer performance:

a. Maximum Attenuation: 0.4 dB/km at 1310 nm; 0.3 dB/km at 1550 nm.

C. Jacket:

1. Jacket Color: yellow for 8/125-micrometer, aqua for 50/125-micrometer cable.
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

2.6 OPTICAL FIBER CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products the following manufacturer:

1. Berk Tek Leviton Solution.

B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.

1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.

C. Patch Cords: Factory-made, dual-fiber cables in 72-inch lengths.

D. Cable Connecting Hardware:

1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
2. Quick-connect, simplex and duplex, Type LC connectors. Insertion loss not more than 0.75 dB.
3. Type SFF connectors may be used in termination racks, panels, and equipment packages.

2.7 GROUNDING

A. Comply with requirements in Division 26 Section "Grounding and Bonding" for grounding conductors and connectors.

B. Comply with ANSI-J-STD-607-A.

2.8 IDENTIFICATION PRODUCTS

A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.9 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test cables on reels according to TIA/EIA-568-B.1.

C. Factory test UTP cables according to TIA/EIA-568-B.2.

D. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.

E. Cable will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 WIRING METHODS

A. Wiring Method: Install cables under raised floors, 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 raceways and boxes specified in Division 26 Sections "Raceways" and "Boxes."

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.2 INSTALLATION OF PATHWAYS

A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A.

B. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.

C. Comply with requirements in Division 26 Sections "Raceways" and "Boxes" for installation of conduits and wireways.

D. Install manufactured conduit sweeps and long-radius elbows whenever possible.

E. Pathway Installation in Communications Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
2. Install cable trays to route cables if conduits cannot be located in these positions.
3. Secure conduits to backboard when entering room from overhead.
4. Extend conduits 3 inches above finished floor.
5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

F. Backboards: Install backboards with 96-inch dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.3 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
8. 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.
9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
10. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.

D. Optical Fiber Cable Installation:

1. Comply with TIA/EIA-568-B.3.
2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

E. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend UTP cable not in a wireway or pathway, a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

F. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.

3. Coil cable as required below each feed point.

G. Group connecting hardware for cables into separate logical fields.

H. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.4 FIRESTOPPING

A. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems."

B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.5 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with ANSI-J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 2 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.6 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A.

1. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Comply with requirements in Division 9 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

C. Comply with requirements in Division 26 Section "Communications Horizontal Cabling" for cable and asset management software.

D. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

E. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.

F. Cable and Wire Identification:

1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.

4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.

    a. Individually number wiring conductors connected to terminal strips and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device with name and number of particular device as shown.
    b. Label each unit and field within distribution racks and frames.

5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

G. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA 606-A, for the following:

1. Cables use flexible vinyl or polyester that flexes as cables are bent.

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:

1. Visually inspect UTP and optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test UTP copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.

    a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

4. Optical Fiber Cable Tests:

a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
b. Link End-to-End Attenuation Tests:

1) Backbone link measurements: Test at 850, 1300, 1310, and1550 nm in one direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.

D. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

E. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

F. End-to-end cabling will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

END OF SECTION 271300

SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general conditions, Division 1, and Basic Electrical Requirements (Section 26 05 00) are part of this section and the contract for this work and apply to this section as fully as if repeated herein.

B. Reference to other sections: The applicable requirements from other Division 26 sections required for a complete and operational system shall form a part of the electrical work and each section shall be thoroughly reviewed by the Contractor for application to all other sections.

1.2 SCOPE

A. Section Includes:

1. Pathways.
2. UTP cabling.
3. Cable connecting hardware, patch panels, and cross-connects.
4. Telecommunications outlet/connectors.
5. Cabling system identification products.
6. Cable management system.

1.3 DEFINITIONS

A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.

B. BICSI: Building Industry Consulting Service International.

C. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel.

D. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

E. EMI: Electromagnetic interference.

F. IDC: Insulation displacement connector.

G. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).

H. LAN: Local area network.

I. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.

J. RCDD: Registered Communications Distribution Designer.

K. Solid-Bottom or Nonventilated Cable Tray: A fabricated structure consisting of longitudinal side rails and a bottom without ventilation openings.

L. Trough or Ventilated Cable Tray: A fabricated structure consisting of longitudinal side rails and a bottom having openings for the passage of air.

M. UTP: Unshielded twisted pair.

1.4 HORIZONTAL CABLING DESCRIPTION

A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.

1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
2. Horizontal cabling shall contain no more that one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
3. Bridged taps and splices shall not be installed in the horizontal cabling.

B. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment. The maximum allowable length does not include an allowance for the length of 16 feet in the horizontal cross-connect.

1.5 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

1.6 SUBMITTALS

A. Product Data: For each type of product indicated.

1. For UPT cable, include the following installation data for each type used:

a. Nominal OD.
b. Minimum bending radius.
c. Maximum pulling tension.

B. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
3. Cabling administration drawings and printouts.
4. Wiring diagrams to show typical wiring schematics, including the following:

    a. Cross-connects.
    b. Patch panels.
    c. Patch cords.

5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
6. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:

    a. Vertical and horizontal offsets and transitions.
    b. Clearances for access above and to side of cable trays.
    c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
    d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.

C. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

D. Source quality-control reports.

E. Field quality-control reports.

F. Maintenance Data: For splices and connectors to include in maintenance manuals.

G. 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. Device address list.
4. Printout of software application and graphic screens.

1.7 QUALITY ASSURANCE AND STANDARDS

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings, and field testing program development by an RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.

3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

B. Testing Agency Qualifications: An NRTL.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

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.

E. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.

F. Grounding: Comply with ANSI-J-STD-607-A.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test each pair of UTP cable for open and short circuits.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.10 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

1.11 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 operating system. 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.

1.12 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Patch-panel units: Four (4) of each type.
2. Device plates: Ten (10) of each type.

PART 2 - PRODUCTS

2.1 PATHWAYS

A. General Requirements: Comply with TIA/EIA-569-A.

B. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.

1. Support brackets with cable tie slots for fastening cable ties to brackets.
2. Lacing bars, spools, J-hooks, and D-rings.
3. Straps and other devices.

C. Cable Trays:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Cablofil Inc.
b. Cooper B-Line, Inc.
c. Cope - Tyco/Allied Tube & Conduit.
d. PW Industries.

2. Cable Tray Materials: Metal, suitable for indoors, and protected against corrosion by electroplated zinc galvanizing, complying with ASTM B 633, Type 1, not less than 0.000472 inch thick.

a. Ladder Cable Trays: Nominally 12 inches wide, and a rung spacing of 9 inches.

D. Conduit and Boxes: Comply with requirements in Division 26 Sections "Raceways" and "Boxes."

1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.

2.2 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements in Division 6 Section "Rough Carpentry" for plywood backing panels.

2.3 UTP CABLE

A. Manufacturers: Subject to compliance with requirements, provide products the following manufacturer:

1. Superior Essex.

B. Description: 100-ohm, 4-pair UTP, with a grey thermoplastic jacket.

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-B.1 for performance specifications.
3. Comply with TIA/EIA-568-B.2, Category 6.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

a. Communications, Plenum Rated: Type CMP, complying with NFPA 262.

2.4 UTP CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by the following manufacturer:

1. Leviton Incorporated.

B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

C. Connecting Blocks: 110-style IDC for Category 6. Provide blocks for the number of cables terminated on the block, plus 10 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.

1. Number of Terminals per Field: One for each conductor in assigned cables.

E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.

1. Number of Jacks per Field: One for each four-pair UTP cable indicated.

F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

G. Patch Cords: Factory-made, four-pair cables in 72-inch and 120-inch lengths; terminated with eight-position modular plug at each end.

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
2. Patch cords shall have color-coded boots for circuit identification.

2.5 TELECOMMUNICATIONS OUTLET/CONNECTORS

A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-B.1.

B. Workstation Outlets: Four-port-connector assemblies mounted in single faceplate.

1. Plastic Faceplate: High-impact plastic. Modular furniture workstation faceplates shall be black with white-text-on-black labels. Standard workstation faceplates shall be white with black-text-on-white labels.
2. For use with snap-in jacks accommodating any combination of UTP, optical fiber, and coaxial work area cords.

a. Flush mounting jacks, positioning the cord at a 90 degree angle.

3. Legend: Machine printed, in the field, using adhesive-tape label.

2.6 GROUNDING

A. Comply with requirements in Division 26 Section "Grounding and Bonding" for grounding conductors and connectors.

B. Comply with ANSI-J-STD-607-A.

2.7 IDENTIFICATION PRODUCTS

A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.8 CABLE MANAGEMENT SYSTEM

A. Manufacturers: Subject to compliance with requirements, provide products by the following manufacturer:

1. Chatsworth Products.

2.9 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test UTP cables on reels according to TIA/EIA-568-B.1.

C. Factory test UTP cables according to TIA/EIA-568-B.2.

D. Cable will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 WIRING METHODS

A. Wiring Method: Install cables under raised floors, 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.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.2 INSTALLATION OF PATHWAYS

A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.

B. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.

C. Comply with requirements in Division 26 Sections "Raceways" and "Boxes" for installation of conduits and wireways.

D. Install manufactured conduit sweeps and long-radius elbows whenever possible.

E. Pathway Installation in Communications Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
2. Install cable trays to route cables if conduits cannot be located in these positions.
3. Secure conduits to backboard when entering room from overhead.
4. Extend conduits 3 inches above finished floor.

5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

F. Backboards: Install backboards with 96-inch dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.3 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
8. 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.
9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
10. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.

D. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

E. Installation of Cable Routed Exposed Under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Coil cable as required below each feed point.

F. Group connecting hardware for cables into separate logical fields.

G. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.4 FIRESTOPPING

A. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems."

B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.5 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with ANSI-J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 2 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.6 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A.

1. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.

B. Comply with requirements in Division 9 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

C. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

D. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.

E. Cable and Wire Identification:

1. Label each cable within 4 inches of each termination, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.

a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or

cabinet to a building-mounted device shall be identified with name and number of particular device as shown.

b. Label each unit and field within distribution racks and frames.

5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

F. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.

1. Cables use flexible vinyl or polyester that flex as cables are bent.

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:

1. Visually inspect UTP cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
2. Visually confirm Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.
3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.

a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

5. UTP Performance Tests:

a. Test for each outlet and MUTOA. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:

1) Wire map.
2) Length (physical vs. electrical, and length requirements).
3) Insertion loss.

4) Near-end crosstalk (NEXT) loss.
5) Power sum near-end crosstalk (PSNEXT) loss.
6) Equal-level far-end crosstalk (ELFEXT).
7) Power sum equal-level far-end crosstalk (PSELFEXT).
8) Return loss.
9) Propagation delay.
10) Delay skew.

6. Final Verification Tests: Perform verification tests for UTP systems after the complete communications cabling and workstation outlet/connectors are installed.

a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.
b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.

D. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

E. End-to-end cabling will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets.

END OF SECTION 271500

SECTION 284621.11 - ADDRESSABLE VOICE FIRE ALARM SYSTEMS

PART 1 - GENERAL

1.1 SCOPE OF WORK

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

B. The scope of work for this project shall consist of a complete fire alarm and emergency voice communication system including the following:
   1. Speaker/strobe notification appliances throughout common areas.
   2. 520 hz low frequency speakers in sleeping units.
   3. 520hz low frequency sounder bases in sleeping
   4. Area smoke detection
   5. Emergency responder radio coverage system monitoring.
   6. Global HVAC/CSFD shutdown.
   7. Elevator recall and power shunt trip
   8. Sprinkler waterflow/tamper monitoring

C. The scope of work includes the acceptance testing to be witnessed by the authority having jurisdiction (AHJ) and the Owner's Representative/Fire Protection Engineer.

D. The scope of work includes the demolition of the existing system and disposal of the unused components off-site.

E. The scope of work includes training the [end-user/client/maintenance contractor] on the operation and programming of the system, required maintenance tasks and frequencies, and the locations of all equipment necessary to maintain and operate the fire alarm system.

1.2 CODES AND STANDARDS

A. Design, equipment, and installation shall be in accordance with the applicable provisions of the following:

   1. California Building Code (CBC), 2022 Ed.
   2. California Fire Code (CFC), 2022 Ed.
   3. California Mechanical Code (CMC), 2022 Ed.
   4. NFPA 70, National Electrical Code (NEC), 2022 Ed.
   5. NFPA 72, National Fire Alarm and Signaling Code, 2022 Ed.
   6. The latest published edition of the equipment manufacturers' product datasheets, technical specifications, installation instructions and wiring guidelines.

B. The systems shall be tested in accordance with the following:

   1. NFPA 72, National Fire Alarm and Signaling Code.

2. The latest published edition of the equipment manufacturers' testing procedures and guidelines.

1.3 ORDER OF PRECEDENCE

A. Should conflicts arise out of discrepancies between documents referenced in this specification, the most stringent requirement shall apply.

B. Should a level of stringency be indeterminable, the discrepancies shall be resolved as follows:

1. Local/State Codes and associated amendments shall take precedence over this specification.
2. The National Fire Protection Association Standards shall take precedence over this specification.
3. This specification shall take precedence over the drawings.

1.4 SUMMARY

A. Section Includes:

1. Fire alarm control unit.
2. Manual fire alarm boxes.
3. System smoke detectors.
4. Multicriteria detectors.
5. Notification appliances.
6. Magnetic door holders.
7. Remote annunciator.
8. Addressable interface device.
9. Digital alarm communicator transmitter.
10. Radio alarm transmitter.
11. Network communications.
12. System printer.
13. Device guards.

1.5 DEFINITIONS

A. EMT: Electrical Metallic Tubing.

B. FACU: Fire Alarm Control Unit.

C. HLI: High Level Interface.

D. NICET: National Institute for Certification in Engineering Technologies.

E. PC: Personal computer.

F. ASSD: Air Sampling Smoke Detection.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product, including furnished options and accessories.

1. Include construction details, material descriptions, dimensions, profiles, and finishes.
2. Include rated capacities, operating characteristics, and electrical characteristics.

B. Shop Drawings: For fire alarm system.

1. Comply with recommendations and requirements in the "Documentation" chapter in NFPA 72.
2. Include plans, elevations, sections, details, and attachments to other work.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Include drawings of detailed connections to interfaced equipment, including, but not limited to, stair pressurization systems, elevators, HVAC units, door holders, and sprinkler systems.
5. Detail assembly and support requirements.
6. Include voltage drop calculations for notification appliance circuits.
7. Include battery size calculations based on the standby requirements, the alarm requirements and spare capacity required herein.
8. Include input/output matrix with a sequence of operations including a detailed description of the operation of each system function for all alarm, supervisory and trouble conditions.
9. Include performance parameters and installation details for each detector.
10. Include voice/alarm signaling service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.

C. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
2. Shop Drawings shall be prepared by persons with the following qualifications:

a. Trained and certified by manufacturer in fire alarm system design.
b. NICET-certified, fire alarm technician; [Level III] minimum.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Field quality-control reports.

1.8 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire alarm systems and components to include in emergency, operation, and maintenance manuals.

B. Following submittal of the current Working As-Built drawings for the Demonstration Test and following [Building Owner/Client] review and approval, the Contractor shall update the Working As-Built drawings as noted in the [Building Owner/Client] review and to reflect the final as-built configuration. Copy and bind into sets.

C. On the bottom right corner of each drawing sheet, the Contractor shall stamp in red letters 1-inch high, the wording "RECORD DRAWINGS."

D. The as-built drawings shall be in a final form for submission for final approvals. Once the as-built drawings are approved, the Contractor shall submit three copies and the updated AutoCAD/REVIT files to the [Building Owner/Client] for distribution.

E. Operation and Maintenance Data: For fire alarm systems and components to include in emergency, operation, and maintenance manuals.

1. Items for "Operation and Maintenance Data," include the following [and deliver copies to authorities having jurisdiction]:
    a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" and "Documentation" chapters in NFPA 72.
    b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" chapter in NFPA 72.
    c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
    d. Riser diagram.
    e. Device addresses.
    f. Record copy of site-specific software.
    g. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" and "Documentation" chapters in NFPA 72, and include the following:

        1) Equipment tested.
        2) Frequency of testing of installed components.
        3) Frequency of inspection of installed components.
        4) Requirements and recommendations related to results of maintenance.
        5) Manufacturer's user training manuals.

    h. Manufacturer's required maintenance related to system warranty requirements.
    i. Abbreviated operating instructions for mounting at fire alarm control unit and each annunciator unit.

F. Software and Firmware Operational Documentation:

1. The Contractor shall provide complete indexed bound sets of the Operation and Maintenance (O&M) manual, as outlined in NFPA 72. These O&M manuals shall include the following in addition to that required in NFPA 72:

    a. The final Equipment List identifying the quantities and types of equipment listed by manufacturer's part number.
    b. An equipment datasheet (or specification sheet) on every piece of fire alarm and emergency voice evacuation system equipment installed.
    c. Standby power calculations and voltage drop calculations that coincide with the equipment that has been installed in the building.
    d. A point ID list referencing the signaling line circuit loops and the devices on those loops.
    e. Complete System Programming

        1) Program Software Backup: On magnetic media, compact disk or portable USB flash drive, complete with data files.

    f. Device labels
    g. Evacuation and alert messages.
    h. The control unit configuration, serial number, access passwords, and a description of remote functions.
    i. Software operating and upgrade manuals.
    j. Printout of software application and graphic screens.

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. Remote Indicating Lamp Units: Quantity equal to [10] percent of amount installed, but no fewer than one unit.
2. Manual Fire alarm Boxes: Quantity equal to [10] percent of amount installed, but no fewer than one unit.
3. Smoke Detectors, Fire Detectors: Quantity equal to [10] percent of amount of each type installed, but no fewer than one unit of each type.
4. Detector Bases: Quantity equal to [two] percent of amount of each type installed, but no fewer than one unit of each type.
5. Keys and Tools: One extra set for access to locked or tamper proofed components.
6. Audible and Visual Notification Appliances: [One] of each type installed.

1.10 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

1.11 PROJECT CONDITIONS

A. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

1.12 WARRANTY

A. The Contractor shall guarantee all new equipment installed and new raceways, new wiring and connections to existing wiring and equipment from defects in workmanship and inherent mechanical and electrical defects for a period of Two (2) years from the date of written acceptance by the [Building Owner/Client]. Warranty shall include Parts and Labor.

B. The Manufacturer or the authorized representative shall guarantee all new system equipment for a period of one (1) years from the date of written acceptance by the [Building Owner/Client].

C. Upon completion of the installation of the fire alarm and emergency voice evacuation system equipment including Acceptance Testing, Demonstration of existing fire alarm, and delivery of all record submittals and spare parts, the Contractor shall provide the [Building Owner/Client] with a signed Completion and Warranty Statement, substantially in the form as follows:

1. "The undersigned, having been engaged as the Contractor on the Fire Alarm Project, confirms that the fire alarm and emergency voice evacuation system equipment was installed in accordance with the system manufacturer's wiring diagrams, installation instructions and technical specifications provided to us by the manufacturer and the [Building Owner/Client] and that the installed system is warranted for a period of two (2) years effective <insert date of [Building Owner/Client] acceptance>. The warranty includes parts and labor to repair or replace (at the [Building Owner/Client] discretion) any and all defects in workmanship or inherent electrical and/or mechanical defects. The installed system includes all new equipment installed and new raceways, new wiring and connections to existing wiring."

D. Emergency Warranty Calls: Provide 24-hr emergency phone number to the [Building Owner/Client] Designated Representative.

E. Warranty Calls: The Contractor's Fire Alarm maintenance personnel shall respond around the clock, seven days per week to trouble services calls within four (4) from the time of notification of a trouble call. The maintenance personnel shall complete warranty call within five working days of notification.

F. The Contractor's Fire Alarm Maintenance Personnel Qualification: Maintenance Personnel must have three years' experience in the installation of fire alarm emergency voice communications systems, certified by the system manufacturer, and possess a minimum LEVEL II certificate from the National Institute for Certification in Engineering Technologies (NICET) in the subfield Fire Protection Engineering Technology (Fire Alarm Systems).

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Noncoded, [UL-certified] addressable system, with multiplexed signal transmission and audible/visual notification ([voice][horn]/strobe) for signaling and/or evacuation.

B. Automatic sensitivity control of analog/addressable smoke sensors.

C. All components provided shall be listed for use with the selected system.

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.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire alarm signal initiation shall be by one or more of the following devices[and systems]:

1. Manual stations.
2. Smoke detectors.
3. Automatic sprinkler system water flow.

B. Fire alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances[, including voice evacuation messages and evacuation tones].
2. Identify alarm and specific initiating device at fire alarm control unit[, connected network control panels, off-premises network control panels,][and remote annunciators].
3. Transmit an alarm signal to the remote alarm receiving station.
4. Release fire and smoke doors held open by magnetic door holders.
5. Activate voice/alarm communication system.
6. Switch heating, ventilating, and air-conditioning equipment controls to fire alarm mode.
7. Close smoke dampers in air ducts of designated air-conditioning duct systems.
8. Recall elevators to primary or alternate recall floors.
9. Activate elevator power shunt trip.
10. Record events in the system memory.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.
2. Elevator shunt-trip supervision.
3. User disabling of zones or individual devices.
4. Loss of communication with any panel on the network.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
4. Loss of primary power at fire alarm control unit.
5. Ground or a single break in internal circuits of fire alarm control unit.
6. Abnormal ac voltage at fire alarm control unit.
7. Break in standby battery circuitry.
8. Failure of battery charging.
9. Abnormal position of any switch at fire alarm control unit or annunciator.
10. Voice signal amplifier failure.

E. System Supervisory Signal Actions:

1. Initiate notification appliances.
2. Identify specific device initiating the event at fire alarm control unit[, connected network control panels, off-premises network control panels,][and remote annunciators].
3. Record the event on system printer.
4. After a time-delay of [200 seconds] <Insert time-delay>, transmit a trouble or supervisory signal to the remote alarm receiving station.
5. Transmit system status to building management system.
6. Display system status on graphic annunciator.

2.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Fire alarm control unit and raceways shall withstand the effects of earthquake motions determined according to [ASCE/SEI 7].

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified[and the unit will be fully operational after the seismic event]."

2.4 FIRE ALARM CONTROL UNIT

A. General Requirements for Fire alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.

a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.
b. Include a real-time clock for time annotation of events on the event recorder and printer.

c. Provide communication between the FACU and remote circuit interface panels, annunciators, and displays.
d. The FACU shall be listed for connection to a central-station signaling system service.
e. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACU shall provide a minimum 500-event history log.

2. Addressable Initiating Device Circuits: The FACU shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACU shall be listed for releasing service.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, [80] <Insert number> characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

C. Initiating-Device, Notification appliance, and Signaling-Line Circuits:

1. Pathway Class Designations: NFPA 72, [Class B]
2. Install no more than [256] addressable devices on each branch of a single signaling-line circuit.
3. Maintain at least [20%] spare capacity on each signaling line circuit.
4. Serial Interfaces:

a. One dedicated RS 485 port for [central-station] [remote station] operation using point ID DACT.
b. One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
c. One [USB] [RS 232] port for PC configuration.
d. One RS 232 port for ASSD HLI connection.
e. One RS 232 port for voice evacuation interface.

D. Notification appliance Circuit:

1. Audible notification appliances shall sound in a three-pulse temporal pattern as defined in NFPA 72 for an evacuation signal.
2. Where notification appliances provide signals to sleeping areas, the alarm signal shall be a 520-Hz square wave with an intensity 15 dB above the average ambient sound level or 5 dB above the maximum sound level, or at least 75 dBA, whichever is greater, measured at the pillow.

3. Visual alarm notification appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.

E. Elevator Recall:

1. Elevator recall shall be initiated only by one of the following alarm-initiating devices:

a. Elevator lobby detectors except the lobby detector on the designated floor.
b. Smoke detector in elevator machine room.
c. Smoke detectors in elevator hoistway.

2. Elevator controller shall be programmed to move the cars to the alternate recall floor if lobby detectors located on the designated recall floors are activated.

F. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls shall [be] connected to fire alarm system.

G. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.

H. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

I. Voice/Alarm Signaling Service: Central emergency communications system with redundant microphones, preamplifiers, amplifiers, and tone generators provided [as a special module that is part of fire alarm control unit].

1. Indicate number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711.

a. Allow the application of, and evacuation signal to, indicated number of zones and, at the same time, allow voice paging to the other zones selectively or in any combination.
b. Programmable tone and message sequence selection.
c. Standard digitally recorded messages for "Evacuation" and "All Clear."
d. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification appliance circuits of fire alarm control unit.

2. Status Annunciator: Indicate the status of various voice/alarm speaker zones

3. Manual Audible Selection: Provide selection switches for all voice/alarm speaker zones on the FACU and all remote annunciators where a microphone is present.

Selection switch zones shall be at minimum one per notification zone and shall include all manual zone groups like stairwells and individual elevator cabs.

4. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.

J. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also, print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.

K. Primary Power:
   1. Provide primary power to fire alarm control equipment via a dedicated branch circuit from electric utility-fed emergency power source compliant with NFPA 70.
      a. Location of the branch circuit disconnecting means shall be permanently identified at the control equipment.
      b. The branch circuit disconnecting means shall be marked to identify the system or equipment that it serves and shall be provided with a red circuit breaker locking device. Provide model number Space Age Electronics ELOCK-FA or equal.
      c. The branch circuit for fire alarm control equipment shall be provided with an overcurrent protective device in accordance with NFPA 70.
   2. 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, [supervisory signals] [supervisory and digital alarm communicator transmitters] [and] [digital alarm radio transmitters] shall be powered by 24-V dc source.
      a. Alarm current draw of entire fire alarm system shall not exceed 80 percent of the power-supply module rating.

L. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

   1. Batteries: [Sealed lead calcium] [Sealed, valve-regulated, recombinant lead acid] [Vented, wet-cell pocket, plate nickel cadmium].
      a. Capacity: Provide secondary power capacity of 24-hours in standby (quiescent) mode and 15 minutes in full alarm mode.
      b. If the primary power branch circuit serving the fire alarm control equipment is provided with an automatic-starting NFPA 110-compliant Type 10, Class 24, Level 1 emergency generator, the secondary power capacity may be reduced to 4-hours in standby (quiescent) mode.

   2. Provide battery calculation for all control units and all battery sets.

M. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.5 MANUAL FIRE ALARM BOXES

A. General Requirements for Manual Fire alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface-mounted, provide manufacturer's surface back box.
   1. Double-action mechanism requiring two actions to initiate an alarm, [pull-lever] type; with [integral] addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire alarm control unit.
   2. Station Reset: Key- or wrench-operated switch.

2.6 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

   1. Comply with UL 268 7th Edition; operating at 24-V dc, nominal.
   2. Detectors shall be [two]-wire type.
   3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire alarm control unit.
   4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
   5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
   6. Integral Visual-Indicating Light: LED type, indicating detector has operated [and power-on status].
   7. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire alarm control unit for calibration, sensitivity, and alarm condition [and individually adjustable for sensitivity by fire alarm control unit].

      a. Rate-of-rise temperature characteristic of combination smoke- and heat-detection units shall be selectable at fire alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.
      b. Fixed-temperature sensing characteristic of combination smoke- and heat-detection units shall be independent of rate-of-rise sensing and shall be settable at fire alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).
      c. Multiple levels of detection sensitivity for each sensor.

B. Photoelectric Smoke Detectors:

   1. Detector address shall be accessible from fire alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
   2. An operator at fire alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

      a. Primary status.
      b. Device type.

c. Present average value.
d. Present sensitivity selected.
e. Sensor range (normal, dirty, etc.).

2.7 MULTICRITERIA DETECTORS

A. Mounting: [Adapter plate for outlet box mounting] [Twist-lock base interchangeable with smoke-detector bases].

B. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire alarm control unit.

C. Automatically adjusts its sensitivity by means of drift compensation and smoothing algorithms. The detector shall send trouble alarm if it is incapable of compensating for existing conditions.

D. Test button tests all sensors in the detector.

E. An operator at fire alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

1. Primary status.
2. Device type.
3. Present sensitivity selected.
4. Sensor range (normal, dirty, etc.).

F. Sensors: The detector shall be comprised of four sensing elements including a smoke sensor, a carbon monoxide sensor, an infrared sensor, and a heat sensor.

1. Smoke sensor shall be photoelectric type as described in "System Smoke Detectors" Article.
2. Carbon monoxide sensor shall be as described in "Carbon Monoxide Detectors" Article.
3. Heat sensor shall be as described in "Heat Detectors" Article.
4. Each sensor shall be separately listed according to requirements for its detector type.

2.8 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Individually addressed, connected to a signaling-line circuit, equipped for mounting as indicated, and with screw terminals for system connections.

B. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.

1. Combination Appliances: Factory-integrated audible and visual appliances in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

C. Visual Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.

1. Rated Light Output:

a. [15] [30] [75] [90] [110] [135] [177] [185] cd. selectable in the field

2. Mounting: Wall or ceiling mounted as indicated.
3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
4. Flashing shall be nominally 1 Hz, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.
6. Mounting Faceplate: Factory finished, [white].

D. Voice/Tone Notification Appliances:

1. Comply with UL 1480.
2. Speakers for Voice Notification: Locate speakers for voice notification to provide the intelligibility requirements of the "Notification Appliances" and "Emergency Communications Systems" chapters in NFPA 72.

E. Lay-In Ceiling Tile Audible Notification Appliance:
1. Where acoustical ceiling tiles are provided and ceiling speakers are provided or required for audible notification or intelligible voice, provide a loudspeaker assembly using a lay-in, ceiling tile loudspeaker.
   a. Provide UL 1490 and UL 2043 complete loudspeaker assembly consisting of a single 8" O.D. (200 mm) transducer installed in a factory-assembled integral enclosure with standard perforated steel grill. Grill finished exposed to the occupied space shall be white baked hybrid epoxy.
   b. The transducer voice coil shall be 1.0 in (25.4 mm) diameter; the loudspeaker cone shall be constructed of molded paper fiber with approved fire-retardant treatment.
   c. Audio signal connection to the loudspeaker assembly shall be a dual set of 150 mm (6 in) 18 AWG pre-cut wire leads. Loudspeaker leads are color coded.
   d. Performance measurement and specification of a typical production unit shall conform to EIA 426A standards:
      1) Sensitivity (SPL at 1m [3.3 ft] with 2.83V input, averaged from 100 Hz to 10 kHz) shall be at least 93 dB-SPL.
      2) Usable frequency response shall extend from 60Hz to 12 kHz (10 dB below rated sensitivity) with no external equalization.
      3) Rated power for nominal 8 ohm unit shall be 20W continuous pink noise.
      4) The loudspeaker shall have a nominal conical polar coverage pattern of 90 degrees (at -6 dB point), averaged 500 Hz to 10 kHz.

e. The loudspeaker shall weigh no more than 8 lb (3.6 kg).

2. Loudspeaker shall be a Quam UL22JB or engineer-approved equal.
   a. The loudspeaker assembly shall be equipped with a universal 25/70V line transformer and 10 microfarad line supervising capacitor. Five tap levels shall be available at 4W, 2W, 1W. 0.5W and 0.25W. Tap selection shall be field-selectable by rotary select transformer. An externally mounted junction box shall be included for wiring termination.
3. Loudspeaker shall be a Quam UL22DM or engineer-approved equal.
   a. The loudspeaker assembly shall be equipped with a universal 25/70V line transformer and 10 microfarad line supervising capacitor. Five tap levels shall be available at 4W, 2W, 1W. 0.5W and 0.25W. Tap selection shall be field-selectable by rotary select transformer. An externally mounted junction box shall be included for wiring termination. An internally mounted junction box with front grill access shall be included with 4 color-coded pass-through wires to external junction box for accessory device mounting.
   b. Visual notification appliances or smoke detectors may be installed on the center-located junction box, as required.

2.9 MAGNETIC DOOR HOLDERS

A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.

1. Electromagnets: Require no more than 3 W to develop 25-lbf (111-N) holding force.
2. Wall-Mounted Units: Flush mounted unless otherwise indicated.
3. Rating: 120-V ac.

B. Material and Finish: Match door hardware.

2.10 REMOTE ANNUNCIATOR

A. Description: Annunciator functions shall match those of fire alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire alarm control unit, including acknowledging, silencing, resetting, and testing.

1. Mounting: [Surface] cabinet, NEMA 250, Type 1.

B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.11 ADDRESSABLE INTERFACE DEVICE

A. General:

1. Include address-setting means on the module.

2. Store an internal identifying code for control panel use to identify the module type.
3. Listed for controlling HVAC fan motor controllers.

B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.

C. Integral Relay: Capable of providing a direct signal [to elevator controller to initiate elevator recall] [to circuit-breaker shunt trip for power shutdown] .

1. Allow the control panel to switch the relay contacts on command.
2. Have a minimum of two normally open and two normally closed contacts available for field wiring.

2.12 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632.

B. Transmission Channels: Unit shall employ a single telephone line (number) as the primary transmission means and one of the following as the secondary transmission means:

1. One-way private radio alarm system.
2. Two-way RF multiplex system.
3. Transmission means complying with NFPA 72, Section 26.6.3 Performance-Based Technologies.
4. A second telephone line (number) meeting the requirements of NFPA 72, Section 26.6.4.1.4(A)(4).

C. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire alarm control unit and automatically capture the selected transmission channel and contact the remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either channel is interrupted for longer than 90 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of transmission channel to the remote alarm receiving station over the other channel. Transmitter shall automatically report transmission channel restoration to the central station. If service is lost on both transmission channels, transmitter shall initiate the local trouble signal.

D. Local functions and display at the digital alarm communicator transmitter shall include the following:

1. Verification that both transmission channels are available.
2. Programming device.
3. LED display.
4. Manual test report function and manual transmission clear indication.
5. Communications failure with the central station or fire alarm control unit.
6. <Insert local function>.

E. Digital data transmission shall include the following:

1. Address of the alarm-initiating device.
2. Address of the supervisory signal.
3. Address of the trouble-initiating device.
4. Loss of ac supply.
5. Loss of power.
6. Low battery.
7. Abnormal test signal.
8. Communication bus failure.

F. Secondary Power: Integral rechargeable battery and automatic charger.

G. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.13 NETWORK COMMUNICATIONS

A. Provide network communications for fire alarm system according to fire alarm manufacturer's written requirements.

B. Provide [Class A] network communications pathway per manufacturer's written requirements and requirements in NFPA 72 and NFPA 70.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.

1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.

B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION

A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."

1. Devices placed in service before all other trades have completed cleanup shall be replaced.

2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.

B. Connecting to Existing Equipment: Verify that existing fire alarm system is operational before making changes or connections.

1. Connect new equipment to existing control panel in existing part of the building.
2. Connect new equipment to existing monitoring equipment at the supervising station.
3. Expand, modify, and supplement existing [control] [monitoring] equipment as necessary to extend existing [control] [monitoring] functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.

C. Install wall-mounted equipment, with tops of cabinets not more than 78 inches (1980 mm) above the finished floor.

1. Comply with requirements for seismic-restraint devices specified in Section 270548.16 "Seismic Controls for Communications Systems."

D. Manual Fire alarm Boxes:

1. Install manual fire alarm box adjacent to FACP
2. Mount manual fire alarm box on a background of a contrasting color.
3. The operable part of manual fire alarm box shall be between 42 inches (1060 mm) and 48 inches (1220 mm) above floor level. All devices shall be mounted at the same height unless otherwise indicated.

E. Smoke- or Heat-Detector Spacing:

1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
3. Smooth ceiling spacing shall not exceed [30 feet (9 m)]
4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex A [or Annex B]in NFPA 72.
5. HVAC: Locate detectors not closer than [36 inches (910 mm)] from air-supply diffuser or return-air opening.
6. Lighting Fixtures: Locate detectors not closer than 12 inches (300 mm) from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.

F. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.

G. Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location. Do not install smoke detectors in sprinklered elevator shafts.

A. Audible Notification Appliances: Install with the tops of the appliances or not less than 90 inches (2.29 m) above the finished floors and not less than 6 inches (150 mm) below the ceiling. Install on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all appliances at the same height unless otherwise indicated.

B. Visual Notification Appliances: Install such that the entire lens is not less than 80 inches (2.03 m) and not greater than 96 inches (2.44 m) above the finished floor. Install all appliances at the same height unless otherwise indicated.

C. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.3 PATHWAYS

A. Pathways above recessed ceilings and in nonaccessible locations may be routed exposed.

1. Exposed pathways located less than 96 inches (2440 mm) above the floor shall be installed in EMT.

B. Exposed EMT shall be painted red enamel.

3.4 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire alarm system.

1. Verify that hardware and devices are listed for use with installed fire alarm system before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches (910 mm) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
1. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
2. Supervisory connections at smoke control fans, dampers, and related components.
3. Control connections for monitored HVAC systems.
4. Smoke dampers in air ducts of designated HVAC duct systems.
5. Magnetically held-open doors.
6. Electronically locked doors and access gates.
7. Alarm-initiating connection to elevator recall and shunt-trip system and components.
8. Supervisory connections at elevator shunt-trip breaker.
9. Alarm-initiating connection to fire protection waterflow switches.
10. Supervisory connections at fire protection valve supervisory switches.
11. Data communication circuits for connection to building management system.

12. Supervisory connections at emergency responder two-way radio communications enhancement system.
13. Supervisory connections at two-way emergency communications systems for rescue assistance.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."

B. Install framed instructions in a location visible from fire alarm control unit.

3.6 GROUNDING

A. Ground fire alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire alarm control unit.

B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.7 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by [authorities having jurisdiction].

B. Perform tests and inspections.

1. Visual Inspection: Conduct visual inspection prior to testing.

    a. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" chapter in NFPA 72.
    b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" and documentation chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
5. Test visual appliances for the public operating mode according to manufacturer's written instructions.
6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals"

chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

C. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

D. Fire alarm system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

F. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

G. Annual Test and Inspection: One year after date of Substantial Completion, test fire alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.8 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include [12] months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Include visual inspections according to the "Visual Inspection Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
2. Perform tests in the "Test Methods" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Perform tests per the "Testing Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.9 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for [two] years.

C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within [two] years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least [30] days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

3.10 DEMONSTRATION

A. [Train] Owner's maintenance personnel to adjust, operate, and maintain fire alarm system.

B. The Contractor shall submit a proposed training agenda for review at least [60] days prior to authorization to proceed.

C. The final, approved training agenda shall be submitted at least [30] prior to the final system acceptance test.

D. Provide three (3) four (4) hour training sessions in the operation and use of the system.

SECTION 31 10 00 - SITE CLEARING

PART 1 – GENERAL

1.1 SUMMARY

A. This Section requires the selective removal and subsequent off-site disposal of the following:

1. Removal and offsite disposal of grass and root mat.

2. Demolition of asphalt concrete and pavements as indicated on the drawings to straight, neatly saw cut surface.

3. All other removals which may or may not been shown on plans as required for the project construction.

1.2 SITE CONDITIONS

A. Protections: Contractor shall provide temporary barricades and other forms of protection to protect general public from injury due to demolition work.

B. Traffic: Conduct demolition operations and debris removal to ensure minimum interference with roads, streets, walks, bike paths, and other adjacent occupied or used facilities. Access must be coordinated with District's Representative.

C. Utility Services: Maintain all existing utilities to remain in service and protect them against damage during demolition operations.

D. Environmental Controls: Use water sprinkling, temporary enclosures, and other methods to limit dust and dirt migration. Comply with governing regulations and County Air Pollution Control District pertaining to environmental protection. Do not use water when it may create hazardous or objectionable conditions such as flooding and pollution.

1.3 REFERENCES

A. *Standard Specifications for Public Works Construction (Green Book),* latest edition.

PART 2 – PRODUCTS

NOT USED

PART 3 – EXECUTION

3.1 DEMOLITION

A. General: Perform demolition work in a systematic manner. Use such methods as required to complete work indicated on drawings in accordance with governing regulations.

B. Provide services for effective air and water pollution controls as required by County Air Pollution Control District regulations.

C. Prior to commencing grading operations, soil containing debris, organics, pavement, or other unsuitable materials, shall be stripped from the foundation and pavement areas. Demolition areas shall be cleared of old foundations, slabs, abandoned utilities, tree roots, and soil disturbed during the demolition process. Depressions or disturbed areas left from the removal of such material shall be replaced with compacted fill.

D. Concrete sidewalks will be removed to the nearest construction or expansion joint to the limits of removal as shown on the plans. Exact locations will be determined in the field by the District's Representative.

3.2 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove from Project site debris, rubbish, and other materials resulting from demolition operations. Transport and legally dispose of off-site.

B. If hazardous materials are encountered during demolition operations, contact District's Representative.

C. Burning of removed materials is not permitted on project site.

3.3 HAZARDOUS MATERIALS

A. Except as otherwise specified, in the event Contractor encounters on the Project site material reasonably believed to be asbestos, polychlorinated biphenyl (PCB), or other hazardous materials which have not been rendered harmless, Contractor shall immediately stop Work in the area affected and report the condition to the District's Representative in writing. The Work in the affected area shall not thereafter be resumed except by written agreement of the Contractor if in fact the material is asbestos, PCB, or other hazardous materials and has not been rendered harmless. The Work in the affected area shall be resumed in the absence of asbestos, PCB, or other hazardous materials, or when such materials have been rendered harmless.

B. Construction involving asbestos cement (transite) pipe shall be performed by qualified personnel in accordance with the standards and specifications set forth by American Water Works Association (AWWA), the Occupational Safety and Health Act (OSHA) and the Environmental Protection Agency (EPA), as well as location jurisdictional codes.

3.4 CLEANUP AND REPAIR

A. General: Upon completion of demolition work, remove tools, equipment and demolished materials from site.

B. Repair demolition performed in excess of that required. Return elements of construction and surfaces to existing condition prior to start of operations. Repair adjacent construction or surfaces soiled or damaged by demolition work.

END OF SECTION

SECTION 31 20 00 – EARTHWORK

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes: Excavation, Compaction, Grading and Fill.

1.2 REFERENCE

A. Standard Specifications for Public Works Construction (SSPWC), latest edition.

B. Geotechniques (2025), "*Geotechnical Study, Student Housing at SW Campus Lot, Ventura College"* Project No. 1003.010.03, dated February 28.

1.3 QUALITY ASSURANCE

A. Codes and Standards: Perform earthwork in compliance with applicable requirements of governing authorities having jurisdiction.

1. Standard Specifications for Public Works Construction (SSPWC), latest edition.

2. CAL/OSHA Construction Safety Order Requirements.

B. Soil Testing Service

1. The District will engage a soil testing service to include testing soil materials proposed for use in the Work and for quality control testing during grading operations.

2. Samples of materials shall be furnished to the testing service by the Contractor at least one week before their anticipated use.

3. Work for this Section includes smoothing out areas for density tests and otherwise facilitate testing work, as directed.

1.4 PROJECT CONDITIONS

A. The Contractor shall visit the site and familiarize himself with existing site conditions.

B. Additional test borings and other exploratory operations may be made by the Contractor at no cost or liability to the District.

C. Existing Utilities:

1. Where uncharted or incorrectly charted piping or other utilities are encountered during excavation, consult District's Representative immediately for directions.

Cooperate with the District's Representative in keeping respective services and facilities in operation. Repair damaged utilities to the satisfaction of the District's Representative at no cost to the District. Disturbed trench sections shall be replaced in kind.

D. Protection of Subgrade: Do not allow equipment to pump, rut, or disturb subgrade, stripped areas, or other areas prepared for Project.

E. Contractor shall implement measures to prevent soil erosion, and where possible, sediment shall be retained onsite.

PART 2 – PRODUCTS

NOT USED

PART 3 – EXECUTION

3.1 SITE PREPARATION

A. General:

1. Remove vegetation, improvements, or obstructions interfering with installation of new construction. Transport and legally dispose of off-site. Contractor shall utilize the best construction method to minimize the erosive effect from the removal of site vegetation.

2. Carefully and cleanly cut roots and branches of trees indicated to be left standing, where such roots and branches obstruct new construction. Paint cuts over one inch in size with tree pruning compound. Care shall be taken so as not to scar any area of the tree's bark.

3. In order to protect from sediment transfer or contamination from urban run-off during construction, the following grading and erosion control practices shall be followed:

a. If grading occurs during the rainy season (November through April), sediment traps, barriers, covers or other methods shall be used to reduce erosion and sedimentation.

b. Excavated materials shall not be deposited or stored where the material can be washed away by high water or storm run-off.

c. Grading operations on site shall be conducted so as to prevent damaging effects of sediment production and dust on the site and on adjoining properties.

d. When vegetation has to be removed on site, the methods shall be one that minimizes the erosive effects from the removal.

e. Exposure of soil to erosion by removing vegetation shall be limited to the area required for construction operations. The construction area shall be fenced to define the project area.

f. Temporary mulching, seeding, or other suitable stabilization shall be used to protect areas during construction or other land disturbance activities on site.

g. Topsoil, removed from the surface in preparation for grading and construction activities on Campus is to be stored on or near the site and protected from erosion while grading operations are underway, provided that such storage may not be located where it would cause suffocation of root systems of trees to be preserved. After completion of such grading, topsoil is to be restored to exposed cut and fill embankments of building pads so as to provide a suitable base of seeding and planting.

h. Sediment basins, sediment traps, or similar control measures shall be installed before extensive clearing and grading operations begin for site development.

i. Water or dust palliatives shall be applied to exposed earth services as necessary to control dust emissions.

j. Revegetation or stabilization of exposed earth surfaces shall take place as soon as possible.

B. Removals

1. Clear the site of trees, shrubs, and other vegetation, which is indicated to be removed.

2. Completely remove stumps, roots, and other debris to avoid problems with future utilities.

3. Use only hand methods for grubbing inside the drip line of trees indicated to be left standing.

4. Existing fills, soil containing debris, organics, pavement, or other unsuitable materials shall be excavated and removed prior to commencing grading operations. Demolition areas shall be cleared of old foundations, slabs, abandoned utilities, landscaping, and soils disturbed during the demolition process. Depressions or disturbed areas left from the removal of such material shall be replaced with compacted fill.

5. The limits and depths for removal of existing fill materials shall be evaluated by project soils engineer during grading.

6. Revegetation or stabilization of exposed earth surface shall take place as soon as possible.

C. Removal of Improvements

1. Remove above-grade and below-grade improvements necessary to permit construction and other work as indicated.

2. Remove from site and legally dispose of off-site, existing fill materials, soil debris, or other unsuitable materials prior to commencing grading operations.

3.2 EXCAVATION

A. Excavation for Pavements: Cut surface under pavements to comply with cross-sections, elevations and grades as shown, within a tolerance of plus or minus 0.04 foot.

B. Excavation for Planting Areas: Conform to cross-sections, elevations and dimensions shown, within a tolerance of plus or minus 0.10 foot.

3.3 COMPACTION

A. General: Fill materials to be compacted to at least 95 percent relative compaction, based on the maximum dry density from ASTM D1557.

B. Percentage of Maximum Density Requirements: Compact soil to not less than the percentages of maximum dry density specified in accordance with ASTM D1557-91 method of compaction.

C. Moisture Control:

1. When moisture content of exposed scarified soil and/or full material is below that sufficient to achieve recommended compaction, water shall be added to the soil and/or fill. While water is being added, soil shall be bladed and mixed to provide relatively uniform moisture content throughout the material.

2. When moisture content of exposed scarified soil and/or fill material is excessive, material shall be aerated by blading or other methods. Fill placed in pavement areas shall be compacted at near optimum moisture content. Jetting is not permitted for compaction.

3.4 FILL

A. In all excavations, use satisfactory excavated or borrow material sampled and tested by the District's Testing Laboratory.

B. Fill excavations as promptly as Work permits, but not until completion of the following:

1. Acceptance by District's Representative of construction below finish grade including, where applicable, waterproofing, damp-proofing, and drainage pipe.

2. Examination, testing, approval and recording locations of underground utilities.

3. Removal of concrete formwork.

4. Removal of shoring and bracing and backfilling of voids with satisfactory materials.

5. Removal of trash and debris.

6. Permanent or temporary horizontal bracing is in place on horizontally supported walls.

7. Protect excavations by methods required to prevent cave-in or loose soil from falling into excavation.

C. Continual dust control, as required by the District, and in accordance with County Air Pollution Control District's Standards shall be required for the project construction.

3.5 GRADING

A. General: To provide support for building floor slabs, all existing fill and unsuitable natural soils shall be excavated and replaced as properly compacted fill.

B. Compaction: After grading, compact subgrade surfaces to the depth and percentage of compaction for each area classification.

C. Fill placement and grading operations shall be performed only under the observation of the District's Testing Laboratory.

D. The exterior grades around building areas shall be sloped to drain away from the buildings to prevent ponding of water adjacent to foundations.

E. Grading operation shall be conducted so as to prevent damaging effects of sediment product and dust on the site and adjoining properties.

3.6 DISPOSAL OF EXCESS AND WASTE MATERIALS

A. Transport excess excavated material and legally dispose of off site.

3.7 FIELD QUALITY CONTROL

A. Quality Control Testing During Construction: District's Testing Laboratory will observe, test and approve subgrades and fill layers before further construction Work can be performed. The District's Representative will determine the frequency of tests. Subgrade: Allow at least one field density test of subgrade to be made for every 2000 sq. ft. of paved area, but in no case less than 3 tests.

B. Field examination and testing will be performed by the District's Testing Laboratory. The Contractor shall cooperate with such testing and shall give the District's Representative advance notice of grading scheduling.

C. Frequency of Tests for Trenching: As determined by the District's Representative.

D. If in the opinion of the District's Representative, based on observations, subgrades or fills which have been placed are below specified density, provide corrective work as specified at no additional expense to the District, and pay for retesting of the soil.

3.8 PROTECTION

A. Protect newly graded areas from traffic and erosion. Keep free of trash and debris.

B. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.

C. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, compact to required density and provide other corrective work as specified, with retesting, prior to further construction.

END OF SECTION

SECTION 31 23 33 - TRENCHING AND BACKFILLING

PART 1 - GENERAL

1.1 SUMMARY

A. Excavating trenches for construction of utilities.

B. Trench backfill materials.

C. Backfilling and compacting requirements.

1.2 REFERENCES

A. *City of San Buenaventura Standard Plans*, latest edition.

B. *Standard Specifications for Public Works Construction (SSPWC),* latest edition.

C. Geotechniques (2025), "*Geotechnical Study, Student Housing at SW Campus Lot, Ventura College"* Project No. 1003.010.03, dated February 28.

1.3 SUBMITTALS

A. Materials source.

B. Sand equivalent test reports per ASTM D2419.

C. Certificates.

D. Drawings for shoring, bracing, sloping, or other provisions for worker protection for any excavation shall conform to the requirements of the CAL/OSHA Construction Safety Orders Requirements.

1.4 EXISTING UTILITIES

A. Drawings show existing major underground utilities from reference drawings. Prior to excavation, the Contractor shall notify the District's Representative to obtain any additional information which may be applicable to the Work.

B. Any incident of a utility being inadvertently damaged by the Contractor shall be immediately shutoff and then be immediately repaired by the Contractor at no cost to the District.

C. Contractor to pothole all utility connections and verify exact size, location and material prior to beginning construction and notify engineer of any discrepancies.

PART 2 - MATERIALS

2.1 APPROVALS

A. Imported material shall be approved by the District's Representative prior to being brought to the site. Provide a sample of the material in sufficient quantity for the District's Representative's use in evaluating the material.

2.2 TRENCH BACKFILL MATERIAL

A. Sand bedding for on-site trench backfill shall have a sand equivalent (SE) of 30 or greater. The SE shall be evaluated during grading. Materials shall conform to Section 306-6 of the SSPWC and meet local governing agency requirements, whichever are more stringent.

B. Slurry Backfill shall be a two-sack slurry mix and shall conform to the requirements of Section 201 of the SSPWC for Backfill Slurry.

C. Aggregate base course shall be per Plan.

D. Topsoil removed from trenches shall be stockpiled at locations approved by the District's Representative.

2.3 SOURCE QUALITY CONTROL

A. Inspection and testing shall be performed by the District's Representative.

PART 3 - EXECUTION

3.1 PREPARATION

A. Identify required lines, levels, contours, and datum.

3.2 TRENCH EXCAVATION

A. All saw cutting shall be neat, straight cuts and shall conform to Section 401 of the SSPWC. All cuts shall be square unless otherwise specifically noted on plans.

B. Prior to trench excavation in landscaped areas, grass and its root mat shall be stripped within excavation footprint and wasted offsite

C. Trench excavation shall conform to Section 306-3 of the SSPWC and the following requirements:

1. The bottom of the trench shall be graded and prepared to provide a firm and uniform bearing throughout the entire length of the pipe barrel. Suitable excavations shall be made to receive the bell of the pipe and the joint shall not bear upon the bottom of the trench. All adjustments to line and grade shall be

made by scraping away or filling in with sand under the body of the pipe and not by wedging or blocking.

2. If the trench is excavated below the required grade, correct any part of the trench excavated below the grade, at no additional cost to the District. Place the backfill material over the full width of trench in compacted layers not exceeding 6 inches deep to the established grade with allowance for the pipe base. If shoring is required, the trenches shall be shored and braced in accordance with the Trench Construction Safety Orders of the Division of Industrial Safety.

3. When subgrade is encountered that in the opinion of the District's Representative is unsuitable for pipe support, the District's Representative may order the excavation to be carried to an approved depth below the bottom of the pipe and backfilled with sand, to the lines and grades shown on the drawings and specified by the District's Representative.

4. The minimum width of the trench at the top of the pipe zone shall be as necessary to install the pipe. The utility lines shall be centered in the trench. In the event of (1) actual physical interference between existing crossing subsurface utilities and the proposed utility lines and (2) vertical discrepancy in connecting proposed utility lines to existing utility system, a minimum clearance of 0.5 feet between the utility line and the crossing, interfering utility shall be provided, unless otherwise indicated on the plans.

5. Where existing utilities or tree roots are to be protected, trench excavation shall be by hand. No mechanical excavating equipment shall be used within 6 inches of any utility or root.

6. Trenching machinery may be used for excavations provided the specified trench width can be maintained.

3.3 TRENCH BACKFILL

A. Pipe bedding and trench backfill materials: Suitable imported pipe bedding for utilities shall consist of material having a sand equivalent of at least 30. The sand backfill material shall be placed within the pipe zone that extends from the bottom of the pipe to at least 12 inches above the top of the pipe for the full width of the trench. The horizontal distance between the springline of the pipe and the side walls of the trench shall be such that bedding material can be properly placed and compacted below the haunches of the pipe. Pipe bedding and pipe zone backfill shall be compacted to at least 95 percent relative compaction. Backfill material placement shall conform to provisions of Sections 306-12 of the SSPWC.

B. Trench backfill placed above the pipe zone shall consist of suitable onsite or imported soil. The trench backfill materials shall be compacted to at least 95 percent relative compaction. Compaction shall be increased to a minimum of 95 percent of maximum dry density within structural fills within building areas. Mechanical compaction of trench backfill shall be performed and water consolidation (jetting) methods of compaction

shall not be permitted. Trench backfill in landscape areas shall be compacted to a minimum of 95 percent relative compaction or per landscape specifications.

1. During the process of laying pipe in trenches, sufficient material shall be carefully placed and hand tamped about the pipe to hold it firmly to established line and grade. Oversized material, broken rock or shale, if encountered, shall not be used for backfill.

2. No motor driven mechanical compacting equipment shall be used over pipelines until the backfill has been compacted to 12 inches over the crown of the pipe.

3. All backfill material shall be deposited in horizontal layers not exceeding the thickness specified in Section 306-12 of the SSPWC and not exceeding 8 inches in thickness. The distribution of materials shall be such that all material following compaction and consolidation will form a homogeneous mass free of voids, pockets, streaks or other imperfections. Backfilling shall be done with earth free from lumps, hardpan, chunks, paving material, organic matter or other deleterious substances.

4. Jetting of bedding or backfill material to obtain specific moisture content or for compaction shall not be permitted. If encountered, existing fill in the utility excavation shall be excavated and recompacted or removed and replaced with new fill materials per requirements of Section 2.2.

5. Compaction of all backfill material for trenches, pavements or structures, shall be per provisions of Sections 306-12 of the SSPWC. Appropriate warning detector tape shall be placed over all utilities.

6. Prior to final cleanup or resurfacing, the District's Representative shall take compaction tests in any backfill area and at any depth, with the Contractor providing equipment and operator to assist in such test. If any such compaction test fails, the Contractor shall correct such failure and pay for any retesting that is required. The District's Representative shall make as many tests as he feels is required to receive a satisfactory and acceptable job.

3.4 STOCKPILING

A. Stockpiling of imported materials or excavated materials shall direct surface water away from approved stockpile site to prevent erosion.

B. After stockpiles are removed, leave area in a clean and neat condition.

3.5 FIELD QUALITY CONTROL

A. Inspection and testing shall be performed by District's Representative.

END OF SECTION

SECTION 32 11 23 - AGGREGATE BASE COURSES

PART 1 - GENERAL

1.1 SUMMARY

A. Aggregate base course for curbs, gutters, sidewalks, and asphalt concrete paving.

1.2 RELATED SECTIONS

A. Section 31 20 00 – Earthwork.

B. Section 32 12 16 – Asphalt Concrete Paving.

C. SECTION 32 13 00 – Concrete Paving.

1.3 REFERENCES

A. *Standard Specifications for Public Works (SSPWC),* latest edition.

B. *ASTM Standards*.

C. Geotechniques (2025), "*Geotechnical Study, Student Housing at SW Campus Lot, Ventura College"* Project No. 1003.010.03, dated February 28.

D. *State Standard Specifications (SSS), Caltrans,* latest edition.

1.4 SUBMITTALS:

A. Submit material samples and reports in accordance with requirements of Owner.

B. Submit samples in sufficient quantities for material testing.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aggregate Base Material shall be Class 2 Aggregate Base conforming to SSS Section 26-1.02A or Crushed Miscellaneous Base (minimum R-value of 78) per SSPWC Section 200-2. Aggregate Base shall be free of organic materials and other deleterious substances.

B. Aggregate Base materials used within building areas shall be free of asphaltic materials.

C. Geotextile fabric shall be Mirafi 600X.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify substrate has been inspected; gradients and elevations are correct, and dry.

3.2 AGGREGATE BASE PLACEMENT

A. Aggregate base placement shall conform to the provisions of the SSPWC, Section 301-2

B. Level and contour surfaces to elevations and gradients indicated.

C. Aggregate base shall be compacted to a minimum relative compaction of 95 percent. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.

D. Where the required aggregate base thickness is 6 inches or less, the watered base may be spread and compacted in one layer. Where the required thickness is more than 6 inches, the aggregate base material shall be spread and compacted in 2 or more layers of approximately equal thickness. The maximum compacted thickness of any one layer shall not exceed 6 inches.

E. Aggregate base course shall be dense and unyielding upon proof-rolling with full water truck.

3.3 TOLERANCES

A. Flatness: Maximum variation of 1/4 inch.

B. Scheduled Compacted Thickness shall conform to the provisions of the SSPWC Section 301-2.2.

3.4 FIELD QUALITY CONTROL

A. Inspection and testing shall be performed by the Owner's Testing Laboratory. Compaction testing will be performed in accordance with ASTM D1557, latest edition.

B. If tests indicate work does not meet specified requirements, remove work, replace and retest at Contractor's expense.

END OF SECTION

SECTION 32 12 16 - ASPHALT CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Asphalt concrete paving for parking lots and driveway pavements.

1.2 RELATED SECTIONS

A. Section 31 20 00 Earthwork.

B. Section 32 11 23 Aggregate Base Courses.

1.3 REFERENCES

A. *Standard Specifications for Public Works Construction (SSPWC),* latest edition.

B. *ASTM Standards.*

C. Geotechniques (2025), "Geotechnical Study, Student Housing at SW Campus Lot, Ventura College" Project No. 1003.010.03, dated February 28.

1.4 SUBMITTALS

A. Submit asphalt concrete mix design(s) for approval of the Owner's Representative.

1.5 TESTING AND INSPECTION

A. Testing and inspection of asphalt pavement mix(es) and testing of placed stabilizing base course and asphalt pavement will be performed by the Owner's Testing Laboratory. Testing and inspection will be performed so as to minimize disruption of work.

B. Allow the Owner's Testing Laboratory access to the mixing plant for verification of weights or proportions, character of materials used and determination of temperatures used in the preparation of asphaltic concrete mix.

PART 2 – PRODUCTS

2.1 GENERAL

A. Provide the aggregate base, and bituminous surface conforming to the requirements of the Standard Specifications for Public Works Construction (SSPWC).

2.2 PAVING MATERIALS

A. Asphalt Concrete: Asphalt concrete material shall be C2-PG 64-10 per SSPWC Section 203-6. The grading and proportioning of aggregates shall be such that the combined mineral aggregate conforms to the specified requirements.

B. Asphalt Emulsion: SSPWC Section 203-3, Grade SS-1h.

C. Prime Coat: Grade SC-70 per SSPWC Section 203-2.

D. Aggregates for base course shall conform to requirements of Specification Section 32 11 23, Aggregate Base Courses.

2.3 ASPHALT PAVEMENT MIX

A. Combine mineral constituents in proportions to produce a mixture conforming to requirements of the SSPWC Section 203-6.

B. Percentage by weight of asphalt cement in mixture shall be in accordance with SSPWC Section 203-6.

C. Maintain thorough and uniform mixture.

D. Bring asphalt and mineral constituents to required temperatures before mixing. Ensure aggregates are sufficiently dry so as not to cause foaming in mixture.

PART 3 – EXECUTION

3.1 GENERAL

A. Execute Work in accordance with SSPWC Section 302.

3.2 PREPARATION

A. Ensure grading of subgrade to required elevation. Subgrade preparation shall be per SSPWC Section 301.

B. Before final rolling, shape entire section, add additional sub-soil if necessary, and compact subgrade to provide grades, elevation and cross-section indicated. Points of finished subgrade surface shall be within 0.04 foot of elevations indicated on the Drawings.

3.3 BASE COURSE

A. Place aggregate base in accordance with requirements of Specification Section 32 11 23, Aggregate Base Courses and SSPWC Section 301 and to the thickness shown on the Drawings. Grade and compact in 6-inch layers to at least 95 percent of compaction (ASTM D1557).

3.4 MAINTENANCE

A. Maintain the base course until the asphaltic pavement is in place. Maintenance shall include drainage, rolling, shaping and water as necessary to maintain the course in proper condition. Maintain sufficient moisture at the surface to prevent a dusty condition. Areas of completed base course that are damaged shall be conditioned, reshaped and re-compacted in accordance with the requirements of the Specifications without additional cost to the Owner.

3.5 TACK COAT

A. Prior to the application of the asphalt concrete, a paint binder (tack coat) shall be applied to all surfaces of walkway, curbs, gutters, manholes and drainage structures which will be in contact with asphalt pavement per SSPWC Section 302-5.4.

B. Coat surfaces of catch basins which are to remain free of asphalt with oil, or provide equivalent protection, to prevent asphalt adhesion.

3.6 PRIME COAT

A. Prior to the application of the asphalt concrete, a prime coat shall be applied at a rate of 0.20 to 0.40 gallons per square yard.

3.7 ASPHALT CONCRETE

A. Requirements: The bituminous concrete shall consist of mineral aggregate, uniformly mixed with bituminous material in a central plant in accordance with SSPWC Section 203-6. The percentage of asphalt binder shall be in accordance with SSPWC Section 203-6. The mixing plant and construction equipment shall conform to the requirements of SSPWC Sections 302-5 and 400-4.

B. Placing: Deliver bituminous mixtures to the work site temperatures specified in SSPWC Section 302-5.5. Spread and place in accordance with SSPWC Section 302-5.5. Asphalt surface shall be fog-sealed.

C. Compaction: Initial or breakdown rolling and the final rolling of the uppermost layer of the asphalt concrete shall be in accordance with SSPWC Section 302-5.6. Compaction by vehicular traffic shall not be permitted.

3.8 JOINING PAVEMENT

A. Carefully make joints between old and new pavements or between successive days work in such manner as to ensure a continuous bond between old and new sections of the course in accordance with SSPWC Section 302.

B. Expose and clean edges of existing pavement. Cut edge to straight, vertical surfaces. Paint all joints with a uniform coat of tack coat before the fresh mixture is placed. Prepare joints in the new pavement in accordance with SSPWC Section 302-5.7.

3.9 JOINING NON-PAVED AREAS

A. Where paving will join landscape or other non-hardscape area a redwood header shall be installed.

3.10 TOLERANCES

A. Flatness: Maximum variation of 1/8 inch when measured with a 10-foot straight edge.

B. Variation from True Elevation: Within 1/4 inch.

3.11 FIELD QUALITY CONTROL

A. Inspection and testing shall be performed by the Owner's Testing Laboratory.

B. Field inspection and testing will be performed by the Owner's Testing Laboratory. The Contractor shall cooperate with such testing and shall give the Owner's Representative advance notice of paving scheduling. Sufficient "Advance Notice" shall be determined by the Owner's Representative.

C. If tests indicate materials do not meet specified requirement, replace material and retest at no additional cost to the Owner.

D. Frequency of Test: As determined by the Owner's Testing Laboratory.

3.12 PROTECTION

A. After placement, protect pavement from mechanical injury.

END OF SECTION

SECTION 32 13 00 - CONCRETE PAVING

PART 1 – GENERAL

1.1 SUMMARY

A. Portland Cement Concrete (PCC) paving for curbs, gutters, sidewalks, parking lots, and driveway pavements.

1.2 RELATED SECTIONS

A. Section 31 20 00 - Earthwork

B. Section 32 11 23 - Aggregate Base Courses

1.3 REFERENCES

A. *Standard Specifications for Public Works Construction (SSPWC),* latest edition.

B. *City of San Buenaventura Standard Plans,* latest edition.

C. *State of California Department of Transportation Standard Specifications (SSS), Caltrans,* latest edition.

D. *American Concrete Institute (ACI) Standards*.

E. *California Building Code (CBC),* latest edition.

F. Geotechniques (2025), "*Geotechnical Study, Student Housing at SW Campus Lot, Ventura College"* Project No. 1003.010.03, dated February 28.

1.4 PERFORMANCE REQUIREMENTS

A. Concrete Pavement: Required compressive strength for concrete pavement shall be 3,500 psi at 28 days per Geotechnical Report.

B. Surface Tolerances: Surface deviation shall not be in excess of 3/16 inch in 10 feet.

C. Thickness Tolerances: Thickness shall not be ½ inch or more less than that specified for an average of no more than 30 percent of the area of the slab.

D. Elevation Tolerances: Variation from indicated elevation within ¼ inch.

E. Cracking: All cracking shall occur within cut or hand tooled control joints.

1.5 SUBMITTALS

A. Product Data: Submit data on admixtures and curing compounds.

B. Concrete Mix Design: Submit current mix design with aggregate gradation, cylinder compression test results, and mix proportioning prior to beginning work. Design shall not be dated prior to three years before start date, which is indicated on the Notice to Proceed.

C. Delivery Tickets: Submit concrete delivery tickets, indicating mix I.D. number, time water was added, elapsed time from when water was added and concrete placed, and amounts of additional water added.

D. Work Schedule: Submit schedule to allow at least 24-hour notice of work to be performed or concrete poured to allow for appropriate schedules for testing and inspection.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with ACI, City of Ventura, and SSPWC Standards.

B. Maintain one copy of each document on site.

C. Obtain cementitious and aggregate materials from same source throughout.

1.7 QUALIFICATIONS

A. Installer: Company specializing in performing work of this section with documented experience.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Do not place concrete when base surface temperature is less than 40 degrees F unless approved by Engineer, or surface is wet or frozen.

B. Concrete placed in cold weather conditions shall be done in accordance with ACI 306.

C. Concrete placed in hot weather conditions shall be done in accordance with ACI 305.

PART 2 – PRODUCTS

2.1 FORM MATERIALS

A. Form Materials: As specified in Section 303-5.2 of the SSPWC.

2.2 REINFORCEMENT

A. Reinforcing for concrete shall be grade 60 steel bars in accordance with SSPWC Section 201-2.

2.3 CONCRETE MATERIALS

A. Concrete materials shall be 3500psi portland cement concrete with C gradation aggregate per SSPWC Section 201-1 for curbs, gutters and site paving. Water cement ratio not to exceed 0.5.

B. Floor and ground surfaces shall be stable, firm, and slip resistant and shall comply with CBC Section 11B-302.

2.4 CONCRETE MIX

A. Mix and deliver concrete in accordance with ASTM C94.

B. Use accelerating admixtures in cold weather only when approved by the Engineer. Use of admixtures will not relax cold weather placement requirements.

C. Use calcium chloride only when approved by the Engineer.

D. Use set retarding admixtures during hot weather only when approved by the Engineer.

2.5 SEALERS

A. Refer to SSPWC Section 201-3 for sealing agents.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify compacted subgrade is acceptable and ready to support imposed loads.

B. Verify gradients and elevations of subgrade are correct.

3.2 PREPARATION

A. Moisten base to minimize absorption of water from fresh concrete. Compact subgrade material to a depth of 12 inches beneath aggregate base to 95 percent relative compaction.

B. Coat surfaces of manhole, catch basin, and valve box frames with oil to prevent bond with concrete pavement.

C. Notify Engineer minimum 24 hours prior to commencement of concreting operations.

3.3 FORMING

A. Place and secure forms to correct location, dimension, profile, and gradient.

B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.

C. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.

3.4 REINFORCEMENT

A. Place reinforcement as indicated on the Plans. Do not deviate from the required position.

B. Place reinforcement to achieve pavement and curb alignment as detailed.

C. Place, support, and secure reinforcement against displacement.

D. Provide doweled joints as indicated at interruptions of concrete (construction joint) at curbs and gutter, and all longitudinal joints.

3.5 PLACING CONCRETE

A. Place concrete in accordance with ACI 301 and 304 and SSPWC Sections 302-6 and 303-5.

B. Place concrete using mechanical screed, slipform or form paving type equipment, which will strike off, consolidate, and finish the pavement to the required cross section. A minimum 10-foot bull float or "bump cutter" shall be used following any paving equipment.

C. Ensure reinforcement, inserts, embedded parts, formed joints, and manhole or valve box lids are not disturbed during concrete placement.

D. Place concrete continuously over the full width of the panel and between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.

E. Use a vibrator of proper speed and size to properly consolidate the concrete when screeding by hand.

F. All curbs shall be poured monolithically.

G. Premolded 0.25-inch thick expansion joints conforming to SSPWC Section 303-5.4.2 shall be placed at ends of all curb returns and around utility poles.

H. Construct weakened plane joints conforming to SSPWC Section 303-5.4.3, 1-inch deep, at intervals not exceeding 10-feet.

I. Score lines conforming to SSPWC, Section 303-5.5.3 shall be made in walks.

3.6 JOINTS

A. Joints shall be per landscape plans and specifications.

3.7 FINISHING

A. Portland cement concrete paving shall be finished per the landscape plans and specifications.

B. Direction of Texturing: per landscape plans and specifications.

3.8 JOINT SEALING

A. Proper cleaning and preparation of joints shall be completed prior to sealing operations, including but not limited to sandblasting per the sealant manufacturer's instructions. A clean joint shall be dry and have no visible signs of residual sealant or debris on the joint face, and will leave no residual cement powder or dust on your finger after rubbing the joint face.

B. All joints, including between pavement and curb and gutter, shall be sealed with joint sealant and backer rod.

C. Do not install sealant when temperature is below the dew point. If rain or other inclement weather occurs during joint preparation or sealing, all operations should cease and sufficient time must be allowed so that the joints are dry prior to starting or continuing the sealing operation.

3.9 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed in accordance with ACI 301.

B. Provide free access to Work and cooperate with appointed firm.

C. Inspection and testing shall be performed by the Owner's Testing Laboratory.

D. The Owner's Testing Laboratory will perform slump and compressive strength tests.

E. Contractor shall maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

3.10 CURING AND PROTECTION

A. Immediately after placement, protect concrete from premature drying, wind, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for a period necessary for hydration of cement and hardening of concrete.

C. Apply curing compound to unformed surfaces immediately after finishing, not to exceed 300 SF per gallon.

D. Remove forms only after concrete has attained sufficient strength to support all dead and live loads.

E. Contractor shall provide barricading or personnel as necessary to protect freshly finished concrete from vandalism or other damage.

F. Do not permit vehicular traffic over pavement for 7 days minimum after finishing.

END OF SECTION

SECTION 321313 – SITE CONCRETE FINISHES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes Concrete finishes for site work as shown on drawings.
   1. Finishing of cast-In-place concrete pedestrian pavement.
   2. Expansion joint material.
   3. Form liner finishing for concrete site walls.

B. Related Sections:
   1. Section 32 13 16.15 “Lithocrete Quarried Stone Paving” for specialty concrete finish to match Lobby interior concrete finish.

1.2 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.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. Coordinate "Qualification Data" Paragraph below with qualification requirements in Section 014000 "Quality Requirements" and as may be supplemented in "Quality Assurance" Article.

B. Qualification Data: For qualified ready-mix concrete manufacturer.

C. Material Certificates: For the following, from manufacturer:
   1. Admixtures.
   2. Curing compounds.
   3. Applied finish materials.
   4. Bonding agent or epoxy adhesive.
   5. Joint fillers.

1.6 QUALITY ASSURANCE

A. 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.Retain subparagraph below if required.
   1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

B. 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 Landscape Architect and not less than 96 inches by 96 inches.
   3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
   5. Provide mockup for all types of concrete paving finishes indicated on plans and in this specification.

1.7 FIELD CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. 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.
   4. 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.

B. 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 CONCRETE PAVING FINISHES AND PRODUCTS

A. Standard grey color. Broom finish. See plans for locations.

B. Surface retarder and top-cast decorative finish. Top-Cast Decorative Finish System by Dayton Superior or approved equal (Dayton Superior Accessories & Chemicals 888-977-9600). Integral color TBD by landscape architect. Integral color by Davis Colors, Scofield, or approved equal. See plans for locations.

C. Integral color black, salt finish. Integral color by Davis Colors, Scofield, or approved equal. See plans for locations.

2.4 CONCRETE SITE WALL INTEGRAL COLOR

A. Integral color by Davis Colors, Scofield or approved equal. Color selection TBD by Landscape Architect.

B. Smooth finish on site walls except where noted on drawings.

2.5 FORM LINER FOR SITE WALLS

A. Form liner finish on site walls, in locations shown on landscape drawings. Random Plank (16938) by Fitzgerald Formliners (714-547-6710, https://formliners.com/) or approved equal.

2.6 CURING MATERIALS

A. Water: Potable.

B. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.

C. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

2.7 RELATED MATERIALS

A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber in preformed strips.

B. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-dispersible, acrylic emulsion or styrene butadiene.

C. Chemical Surface Retarder: Water-soluble, liquid, set retarder with color dye, for horizontal concrete surface application, capable of temporarily delaying final hardening of concrete to a depth of 1/8 to 1/4 inch.

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 Landscape Architect from manufacturer's full range.

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 "Earthwork."

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 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. Provide tie bars at sides of paving strips where indicated.
   3. 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, other fixed objects, and where indicated.
   1. Locate expansion joints at intervals of 30 feet unless otherwise indicated.
   2. Extend joint fillers full width and depth of joint.
   3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
   4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
   5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
   6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows, to match jointing of existing adjacent concrete paving:
   1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 3/8-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.
      a. Tolerance: Ensure that grooved joints are within 3 inches either way from centers of dowels.

E. 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.

3.5 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. 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.

3.6 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.

E. Curing Methods: Cure concrete by curing compound as follows:
   1. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.7 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. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
   5. Joint Spacing: 3 inches .
   6. Contraction Joint Depth: Plus 1/4 inch , no minus.
   7. Joint Width: Plus 1/8 inch , no minus.

3.8 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

SECTION 32 13 16.15 - LITHOCRETE QUARRIED STONE™ (LQS™) PAVING

PART 1 - GENERAL

1.1 GENERAL CONDITIONS

A. Requirements of "General Conditions of the Contract" and of Division 1, "General Conditions," apply to work in this Section with same force and effect as though repeated in full herein.

1.2 SCOPE OF WORK

A. Furnish materials, labor, transportation, services, and equipment necessary to furnish and install Lithocrete® architectural concrete paving incorporating the patented Lithocrete® process as indicated on Drawings and as specified herein.

B. Work included in this Section:
1. Lithocrete® architectural concrete products and concrete installations are covered by one or more of the following United States Letters Patents: 5,794,401; 5,887,339; 5,950,394; 6,016,635; 6,033,146; 6,082,074; 6,112,487; 7,322,772; 7,493,732; 7,607,859; 7,614,820; 7,670,081; 7,781,019. Other patents pending. Lithocrete, Lithocrete Thin Tech, Lithocrete Presto, Presto Pneumatic Spray, and LQS are registered trademarks of Lithocrete Inc.
2. Only experienced Architectural Cast-in-place Concrete installers, certified to install (Lithocrete®) are acceptable for this project. Acceptance of certification will be based on proof of certification, experience and approved samples and mockups to be provided within 30 days after Notice to proceed. If timeframe is exceeded, suitable certification/experience is not provided, or mockups are unacceptable – installer will not be eligible to install project.
3. Approved sample #[TBD] for this project are available at (location TBD), as prepared by T.B. Penick & Sons, Inc. Contact T.B. Penick & Sons, Inc., *Frank Klemaske*, 858.558.1800.

C. Work related in other Sections:
1. Section 321300 - Concrete Paving: Adjacent concrete paving.
2. Section 328400 – Landscape Irrigation: Coordination of irrigation sleeve installation.
3. Section 329300 - Landscape Planting: Coordination of plant material placement.
4. Section 079200 – Joint Sealants: Installation of caulking.

1.3 REQUIREMENTS OF REGULATORY AGENCIES

A. Federal, State and local laws and regulations governing this Work are hereby incorporated into and made part of this Section. When this Section calls for certain materials, workmanship, or a level of construction that exceeds the level of Federal, State, or local requirements, provisions of this Section take precedence.

1.4 APPLICABLE STANDARDS

A. Specifications and recommended practices of American Concrete Institute (ACI), American Society for Testing and Materials (ASTM), The Uniform Building Code, and under one or more U.S. Patents 5,794,401; 5,887,339; 5,950,394; 6,016,635; 6,033,146; 6,082,074; 6,112,487; 7,322,772; 7,493,732; 7,607,859; 7,614,820; 7,670,081; 7,781,019 and U.S. Trademarks #1,879,329, # 2,358,183 # 2,358,054 referred to in this Specification with their individual designations are to be considered part of this Specification.

B. Design and Control of Concrete Mixtures – Thirteenth Edition; Portland cement Association.

1.5 QUALITY CONTROL

A. Basis of Design: The standards named herein are specified to establish standards of quality, performance, and compliance with the design intent, which is the Lithocrete process.

B. Paving Subcontractor Qualifications: provide evidence to indicate successful experience in providing Lithocrete® similar to that specified herein and demonstrate successful experience.

C. As part of the bid submittal the General Contractor shall submit background information/qualifications on his Architectural Cast-in-place Contractor certified for Lithocrete® installation. This information shall provide evidence to indicate successful experience in providing concrete work identical to that specified herein. A listing of projects shall be provided and shall be reviewed and approved as comparable projects to the specified work by the Owner or Architect prior to award of bid. Failure to provide this information or the submittal of incomplete or inaccurate information shall give cause to reject the entire bid as non responsive and incomplete. The submittal shall provide the Owner and Architect with evidence of successful experience in Lithocrete® similar to that specified herein and can demonstrate successful experience through past project documentation and references.

D. Demonstration of experience: provide a minimum of five (5) projects of installed Lithocrete architectural cast-in-place concrete totaling at least 200,000 square feet with a reference list of each containing address of installation, contact person and phone number of project's architect or owner's representation. Minimum size of each individual installation shall be 10,000 square feet. Provide two (2) color photos, 8" x 10" size, of each installation listed above representing the installation. Photo #1 shall show the approximate size of the installation. Photo #2 shall be taken approximately 2 to 3 feet from the paving surface. See submittals portion of this section for additional information.

E. Supervision: On site superintendent must have a minimum of 10 years experience installing Architectural Cast-in-place concrete. See submittals portion of this section for additional information.

1.6 SITE INSPECTION

A. Verify conditions at site that affect work of this Section.

B. Take field measurements as required.

C. Report major discrepancies between Drawings and field dimensions to Owner's Authorized Representative prior to commencing work.

1.7 SUBMITTALS

A. Product Data: Submit no later than 10 days after contract award a typed list of products specified in this Section.

B. Submit evidence of installer qualifications, demonstration of square footage installed, number of projects, and contact information to verify experience; evidence of supervisor experience as indicated in Quality Control Section of this specification.

C. Shop Drawings:
1. Paving Jointing and Pour Sequence Plan - submit six blueprints indicating the following:
   a) Proposed layout of contraction, construction and isolation joints. Clearly delineate the three different joint types.
   b) Layout of paving types as indicated on Drawing Paving Schedule. Give overall dimensions of each paving type.

D. Statement of Mix Design: Submit (1) copy of Statement of Mix Design prepared by batch plant servicing Project for each load delivered to Project. Statement of Mix Design to contain following information:
1. Name, address, and telephone number of batch plant preparing statement of mix design.
2. Date of mix design.
3. Project location.
4. Contractor requesting load delivery.
5. Mix design number.
6. Integral color used.
7. Gradation for sand and aggregate.
8. Material weights, specific gravity, and absolute volumes.
9. Basis of testing, i.e. UBC 2605 D4 and Title 24 2604 D4.
10. Water/cement ratio.
11. PSI rating.

E. Lithocrete® Surface-Seeded Aggregate (extra stock):
1. One 1-pound sample of each Lithocrete® aggregate specified.

F. Washed Concrete Sand (extra stock):
1. One 50-pound sealed bag of washed concrete sand similar to type used during installation of Lithocrete®.

1.8 SUBSTITUTIONS

A. None allowed unless approved in writing by Owner's Authorized Representative.

1.9 TESTING

A. A testing agency may be designated by Owner or Owner's Authorized Representative. Testing personnel to meet ASTM E329 requirements.

1.10 MOCK-UPS

A. Prior to construction, provide (1) 4-foot x 4-foot x 4-inch sample of each Lithocrete® paving type specified on Drawings.

B. Ensure that each mock-up contains joint types specified on project, i.e. construction, contraction, and isolation.

C. Locate mock-ups in a conveniently accessible and protected place. Approved mock-ups will be standard for future Lithocrete® installation review.

D. Remove mock-ups from site upon completion of Work and approval by Owner's Authorized Representative.

1.11 PROJECT CONDITIONS

A. Keep Work area clean, and in a safe and workmanlike condition so that rubbish, waste and debris do not interfere with work of other trades.

1.12 PRODUCT HANDLING

A. Store materials in a dry and protected location. Protect reinforcing steel and dowels from rusting, deformation, staining, and moisture damage.

B. Keep Lithocrete® aggregate dry at all times prior to installation.

1.13 COORDINATION

A. Notify Owner's Authorized Representative and contractors performing work related to installation of Contractor's Work in ample time, so as to allow sufficient time for them to perform their portion of work.

B. Concrete pour sequence plan to be generated during preconstruction phase.

PART 2 - PRODUCTS

2.1 PORTLAND CEMENT

A. Type I, IA, IL, II, IIA, III, IIIA, IV, and V cements, to conform to ASTM C150.

B. Use same brand of cement from single source throughout entire project.

2.2 WASHED CONCRETE SAND

A. Clean, hard, and durable washed concrete sand, conforming to ASTM C33.

B. Use same sand from single source throughout entire project.

2.3 COARSE AGGREGATE

A. Clean, hard, and durable coarse aggregate, conforming to ASTM C33.

B. Use same aggregate from single source throughout entire project.

2.4 LITHOCRETE® SURFACE-SEEDED AGGREGATE

A. Refer to Drawings for specified Lithocrete® surface-seeded aggregate type, size, color, and distribution percentage. Lithocrete Quarried Stone finish Sample #[TBD]

B. Use same Lithocrete® surface-seeded aggregate from same source for each paving type specified throughout entire project.

2.5 WATER

A. Free from deleterious materials such as oils, acids, and organic matter.

2.6 ADMIXTURES

A. Integral Concrete Coloring Admixture: Refer to Drawings for color type and manufacturer.
   1. Acceptable Manufacturers:
      a. L.M. Scofield; (800) 800-9900.
      b. Colorfull by Admixtures, Inc.; (626) 357-3263.
      c. Davis Color (323) 269-7311
      d. Solomon Colors (800) 624-0261
      e. Increte/The Euclid Chemical Company (800)752-4626

B. Air Entrainment Admixtures: Conforming to ASTM C260.
   1. Acceptable Manufacturers:
      a. GCP Applied Technologies; Daravair®, (800) 433-0020 or www.gcpat.com
      b. Master Builders, Inc.; Micro-Air®, (800) 628-9990 or www.masterbuilders.com/MB/pub/Product.asp?TypeCat=2&ParentID=78&ProductID=22.
      c. The Euclid Chemical Company; AEA or Airmix Series (800) 752-4626 www.euclidchemical.com
      d. or approved equal

C. Water Reducing Admixtures: Conforming to ASTM C494, Type A.
   1. Acceptable Manufacturers:
      a. GCP Applied Technologies; WRDA® (800) 433-0020 www.gcpat.com

b. The Euclid Chemical Company; Eucon Series (800) 752-4626 www.euclidchemical.com
c. or approved equal

D. Shrinkage Reducing Admixtures: Conforming to ASTM C157.
1. Acceptable Manufacturers:
a. GCP Applied Technologies; Eclipse® (800) 433-0020 www.gcpat.com
b. BASF; Tetraguard (800) 228-3318 or http://www.basf-admixtures.com/en/products/shrinkage_reducing/tetraguard_as20/Pages/default.aspx
c. The Euclid Chemical Company; Eucon SRA (800) 321-7628 www.euclidchemical.com
d. or approved equal

E. ASR Mitigation Admixture (if required):
1. Acceptable Manufacturers:
a. GCP Applied Technologies; RASIR® (800) 433-0020 www.gcpat.com
b. or approved equal

2.7 READY MIXED CONCRETE

A. Batched, mixed and transported in accordance with ASTM C94 - "Specifications for Ready Mixed Concrete."

2.8 REINFORCING

A. Reinforcing Steel: Conforming to ASTM A615, clean and free of rust, dirt, grease or oils.

B. Tie Wire: 16-gauge plain cold-drawn steel conforming to ASTM A82, clean and free of rust, dirt, grease or oils.

C. Supports for Reinforcement:
1. Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bars in place.

D. Polypropylene Fiber Reinforcement: 100% virgin multifilament polypropylene fibers, complying with ASTM C 1116 - Type III.
1. Acceptable Manufacturers:
a. Fibermesh; Fibermix Stealth® (423)892-8080 or www.fibermesh.com/family/stealth.htm.
b. GCP Applied Technologies; MicroFiber™ (800)433-0020 or www.graceconstruction.com/concrete/fibers.html
c. Master Builders Solutions; MasterFiber M 100 +44 (0) 161-727-6300
2. Application Rate: 1/2 lb. /cy of mix.

2.9 ISOLATION JOINT MATERIALS

A. Refer to Section 079200 – Joint Sealants for isolation joint construction.

2.10 CONSTRUCTION JOINT DOWELS

A. Speed dowels to be used for slabs 4" thick or less.

B. Slabs 4" thick or less with radius cuts require plate dowels with a minimum 6" thickened edge.

C. Construct Diamond Dowel Construction joints at modules no larger than 20'-0" x 20'-0".

D. Dowel schedule to match rebar schedule at a minimum spacing of 24-30"o.c.

E. 1/4-inch-thick diamond shaped load plate, free of dirt, grease, and oils. Contact PNA Construction Technologies at (800) 542-0214 or http://www.pna-inc.com/products/square_dowel_basket/ or contact local suppliers such as White Cap.

2.11 FLY ASH or SLAG (if required)

A. ASTM C618 - Type F.

2.12 CURING COMPOUND

A. Concrete Curing Compound
1. Acceptable Manufacturers
   a. Sinak Lithium Cure 1000
   b. Admixtures Inc.; Colorful Clear Curing Compound – (626) 357-3263 or http://admixtures.home.att.net/
   c. Cure & Sealer Lithocrete® Sealer or HLQ 125.

PART 3 - EXECUTIONS

3.1 SUBGRADE

A. Subgrade to meet requirements of project's soil report.

B. Ensure that a minimum 4-inch layer of FREE DRAINING graded washed aggregate or clean washed and graded concrete sand compacted to 95 percent relative compaction is placed over subgrade prior to placing concrete.

C. Place all aggregate base material to a smooth plane ensuring proper slab design thickness to a tolerance plus or minus ½".

D. Ensure that utilities, including irrigation lines are buried and compacted below bottom of sand layer.

E. Keep sand damp prior to placing concrete.

3.2 FORMING

A. Be responsible for design and engineering of formwork as well as its construction.

B. Ensure that Work conforms to recommended practice for concrete formwork (ACI 347), latest edition.

C. Do not exceed 20-feet by 20-feet in a formed construction area.

D. Ensure that form lumber is new #2 or better grade wood. Do not use used form lumber.

E. Perform form layout with a digital electronic transit for line layout accuracy.

F. Allow forms to remain in place long enough to allow concrete to set properly. Remove forms when appropriate.

3.3 DESIGN OF MIXES AND PROPORTIONING

A. Proportion and mix of cement, aggregate, admixture and water to attain required plasticity and strength in accordance with current edition of ACI Manual of Concrete Practice and PCA "Design and Control of Concrete Mixtures."

B. Concrete mixtures to be designed by an approved commercial testing laboratory, using approved materials to obtain specified minimum compressive strength.

C. Concrete Mix Criteria:
1. Slump: 4-inch, with a 1-inch slump differential between successive batches. Obtain approval from Owner's Authorized Representative if slump is outside these parameters.
2. Minimum PSI Rating at 28 days: 3,000 or per soils report.
3. Sand: 50-55% of total mix.
4. Blended Gravel: 45-50% of total mix
5. Admixtures:
6. Air entrainment: Per local standards
7. Shrinkage Reducing: Do not exceed 2% by weight of cement.
8. Fly ash: Use only when seeding reactive Lithocrete™ aggregates such as glass and seashells or per item 2.11 above. If fly ash is not available, utilize approved equal to mitigate alkali silica reaction.
9. Non-Chloride Accelerators: Do not use corrosive accelerators such as calcium chloride.
10. Concrete Delivery: Use of concrete loads exceeding 90 minutes from time of batch plant must be approved by Owner's Authorized Representative.
11. Ensure that batch plant guarantees single source supply for cement, sand, and aggregate for the entire project.
12. Final mix designs shall be based on criteria above and meet critical minimum points stipulated in items 2,4, and 7 above. Other items may vary by geographical region and required certain modifications shall in no way compromise the strength and integrity of the mix design stipulated.

D. Architectural Cast-in-Place Concrete mixes are based on samples created for this project. The mix designs involve different Architectural Cast-in-place Lithocrete finishes as indicated in Drawings.

3.4 LITHOCRETE® SURFACE-SEEDED AGGREGATE INSTALLATION

A. Lithocrete® is a patented paving process. Installation of Lithocrete® surface-seeded aggregate must be performed by a licensed Lithocrete® installer only.

B. For certified Lithocrete® installers, see elsewhere in this specification or contact Lithocrete® at 800-899-9921

C. Lithocrete® is to be installed in accordance under one or more U.S. Patents 5,794,401; 5,887,339; 5,950,394; 6,016,635; 6,033,146; 6,082,074; 6,112,487; 7,322,772; 7,493,732; 7,607,859; 7,614,820; 7,670,081; 7,781,019 and U.S. Trademarks #1,879,329, # 2,358,183 # 2,358,054.

D. Lithocrete® process incorporates use of following patented products:
1. Lithocrete® Conditioner™.
2. Lithocrete® Etch Retarder®.
3. Lithoseal™ paving sealer.
4. Lithocrete® vibrating float process – use patent # 6,016,635
5. Lithocrete® power trowel process – use patent # 6,016,635

3.5 JOINTING

A. Refer to ACI 302 "Guide for Concrete Floor and Slab Construction" for work under this section.

B. Construction and Contraction Joints:
1. Saw-cut construction and contraction joints in locations indicated on Drawings.
2. Perform jointing with a new diamond tip circular saw.
3. Joint Width: Per Drawings. Do not exceed 3/16-inch in width.
4. Depth of sawcuts: 1/4th depth of slab.
5. Decorative Saw-cut Joints: Per Drawing.
6. Saw-cut joints in a straight line with no over-cutting.
7. Use a hand tool to saw-cut up to vertical edges such as walls, steps, curbs and columns. No cutting into vertical surfaces will be allowed nor shall saw-cuts be allowed to stop short of vertical surfaces and allowed to crack at the end.
8. All saw-cuts shall be further treated with a Soft-Cut beveled blade or sealed with structural silicone joint sealant to to be determined by Architect.

C. CONSTRUCTION JOINT DOWELS
1. Construct Diamond Dowel Construction Joints and Dowel Basket Joints at modules no larger than 20'-0" x 20'-0".
2. Dowel schedule to match rebar schedule at a minimum spacing of 24-30"o.c.

3. ¼-inch-thick diamond shaped load plate, free of dirt, grease, and oils. Contact PNA Construction Technologies at (800)542-0214 or http://www.pna-inc.com/products/square_dowel_basket/ or contact local suppliers such as White Cap.

D. Isolation Joint Caulking:
1. Install isolation joint caulking to be installed under Section 07900 – Joint Sealers.

3.6 CURING

A. After Lithocrete® is placed, cure concrete for a minimum of seven (7) days without foot traffic and a minimum thirty (30) days without vehicular traffic. If a curing compound is required, refer to Section 2.12 of this specification for acceptable curing compounds for use with Lithocrete or install a moisture retaining, non-staining, non-woven, curing cover and maintain sufficient moisture under cover to provide for 100% humidity conditions at Lithocrete® surface for a minimum of 7 days. Cover shall be reflective in nature to prevent excessive heat build up under cover and allow for optimal curing conditions.

3.7 SEALING

A. Seal surface of paving using Lithocrete® Sealer also apply Semco X-Crete 500, Semco Satin Stone, or Spec Chem sealers.

B. Final cleaning, staining, caulking, and sealing operations shall not commence until Lithocrete® surfaces have been completely and properly cured or 28 days whichever is later.

C. Follow Lithocrete® Sealer directions when applying.

END OF SECTION

VENTURA COLLEGE - STUDENT HOUSING

REQUIRED ARCHITECTECTURAL CAST-IN-PLACE CONCRETE SUB-CONSULTANT INFORMATION

The proper installation of specialty concrete finishes such as Lithocrete® is critical to the success of the project. The bidder, or the bidder's subcontractor, shall have at least 200,000 square feet with five (5) or more LQS™ projects installed. Minimum size of individual installations shall be 10,000 square feet.

I. LICENSED LITHOCRETE INSTALLER

- Contractor:_____
- Project Manager/Foreman:_____
- Phone Number:_____

II. COMPARABLE PROJECT LIST (PROVIDE MINIMUM OF 5)

1. Project Name: _____
   Address:_____
   Name of Contact:_____
   Phone Number: _____

2. Project Name: _____
   Address:_____
   Name of Contact:_____
   Phone Number: _____

3. Project Name: _____
   Address:_____
   Name of Contact:_____
   Phone Number: _____

4. Project Name: _____
   Address:_____
   Name of Contact:_____
   Phone Number: _____

5. Project Name: _____
   Address:_____
   Name of Contact:_____
   Phone Number: _____

Provide two (2) color photos, 8"x10" in size, of each installation listed above. Photo #1 shall show the approximate size of the installation. Photo #2 shall be taken approximately 2 to 3 feet from the respective paving surface. Photos shall clearly show the detail associated with the Lithocrete® finish or the photo(s) will be rejected. The bidder must submit the above information along with the color photos with the bid. Failure to submit the information and

photos shall be considered a non-responsive bid and therefore the bidder shall be considered non-responsive.

_____

_____

Signature of Bidder

Date

SECTION 321413 – INTERLOCKING CONCRETE UNIT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Interlocking Precast Concrete Pavers: Provide all labor, materials, equipment, services and layout required for and incidental to the installation of concrete pavers, including subgrade preparation and base rock.

1.2 RELATED SECTIONS

A. Related requirements specified elsewhere include:
   1. Section 31 20 00, “EARTHWORK”.
   2. Section 32 13 13, “CONCRETE PAVING”.
   3. Section 32 93 00, “LANDSCAPE PLANTING” for metal edging.
   4. Section 33 41 00, “STORM DRAINAGE UTILITIES”.

1.3 REFERENCES

A. Perform all work in accordance with all applicable laws, codes and regulations required by State of California.

B. Reference to "Standard Specifications" shall mean the Standard Specifications of the State of California, Business and Transportation Agency, Department of Transportation, CALTRANS. Reference to CALTRANS shall conform to the appropriate current sections of the CALTRANS Standard Specifications as they reasonably apply to this work, except for measurement and payment requirements.

C. Interlocking Concrete Pavement Institute (ICPI)

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. In addition to manufacturer's standard product data for each manufactured product, submit the following:
   1. Minimum 3 copies of product cut-sheet and product literature.
   2. Minimum 3 set(s) paver samples indicating full range of color and texture to be expected in completed work.
   3. Edge restraints

B. Waterbase Sealer: Minimum 3 copies of product cut-sheet and product literature.

C. Polymeric Joint Stabilizing Sand: Minimum 3 copies of product cut-sheet and product literature. Joint Sand Color – T.B.D.
   1. Samples for Initial Selection: Submit manufacturer's color charts or cured samples illustrating the full range of available colors for polymeric joint sand.

D. Shop Drawings: Indicate location and size of each; elevation of each type; construction details not covered in Product Data; and the following:
   1. Show layout patterns, dimensions, and joint alignments.
   2. Indicate locations of different colors, finishes, and paver types.
   3. Include transition and blending areas where paver colors or finishes change.
   4. Show edges, bands, and trim pavers, including relationships to adjacent materials.
   5. Identify slope directions, drain inlets, and other site features influencing layout.
   6. Coordinate with other trades as required.

1.6 INFORMATIONAL SUBMITTALS

A. Material Certificates: For unit pavers. Include statements of material properties indicating compliance with requirements, including compliance with standards. Provide each type and size of unit.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for unit pavers, indicating compliance with requirements.

1.7 QUALITY ASSURANCE

A. Mockups:
   1. Construction Quality Mockup: Construct a minimum 4'-0" x 4'-0" sample area at the job site with 2x4s and vibrate in place, including polymeric sand joints and any trim pavers and/or bands through the paver field with metal edging. This mockup is intended to establish acceptable standards for installation quality, joint treatment, and finish appearance.
   2. Appearance Mockups: Provide two (2) paver layout mockups, each approximately 5'-0" wide x 20'-0" long, to evaluate river-like patterning using two paver types of the same size with varying colors and finishes. Layout mockups shall be dry-laid without sand joints or base to review color transitions, pattern flow, and paver ratios. Final patterning and ratio information will be provided prior to mockup construction.
   3. Protect all mockups until unit paving work is accepted. Locate mockups where directed by Owner's Representative.

B. A person who is thoroughly familiar with the type of materials being installed and the methods for their installation shall be present at all times during execution of the work.

C. Installation of interlocking paving stones (pavers) shall be by a pre-qualified specialty contractor that has been certified by the interlocking concrete paver manufacturer and/or the ICPI. The licensed specialty contractor shall possess a minimum of (3) years'

experience in the interlocking paving stone industry and must have satisfactorily completed projects of similar size and scope.

D. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

E. Testing and inspection, per Section 014000.

F. Materials and installation shall meet Interlocking Concrete Pavement Institute (ICPI) specifications and requirements specified herein.

G. If "Profiled Pavers" (pavers with rounded wearing surfaces) are required, they shall be protected from scuffing during compaction using a woven geotextile such as Mirafi 500X or other method. Scuffed pavers shall be replaced as directed by Owner's Representative.

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 aggregates where grading and other required characteristics can be maintained and contamination avoided.

C. Store liquids in tightly closed containers protected from freezing.

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.

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. Subject to requirements provide pavers by the basis of design manufacturer or approved equal.

2.2 INTERLOCKING PAVER: Pavers shall be in accordance with the drawings, patterns, and details as shown on the plans and/or contained within these specifications. Pavers shall

be produced by a single source manufacturer in accordance with ICPI standards and guidelines and shall conform to the following specifications.

A. Paver Types:

1. Unit Paver Type A (50%)
   a. Manufacturer: Hanover
   b. Model: Traditional® Prest® Brick
   c. Size: 6-inches x12-inches
   d. Thickness: 2 3/8" thick
   e. Color: Light Gray with exposed aggregate #B91875
   f. Finish: Ground Finish
   g. Edge condition: 3/16" Bevel

2. Unit Paver Type B (50%)
   a. Manufacturer: Hanover
   b. Model: Traditional® Prest® Brick
   c. Size: 6-inches x12-inches
   d. Thickness: 2 3/8" thick
   e. Color: Light Brown with exposed aggregate #B91914
   f. Finish: Ground Finish
   g. Edge condition: 3/16" Bevel

3. Provide owner with 5% added stock of all paver types for future repairs not in Contract.

B. Pavers shall have a minimum compressive strength of 8,000 psi in accordance with testing procedures ASTM C936.

C. Materials used to manufacture interlocking concrete paving pavers conform to the following:

D. Cement: ASTM C150 (Portland Cement)

E. Aggregates: ASTM C33 (washed, graded sand and rock; no expanded shale or lightweight aggregates).

F. Method of manufacturing pavers to be single-layer production to ensure dimensional uniformity, optimum color blending, and product strength and durability. Colors are to be integral throughout unit paver or face-mixed concurrent to project conditions. Multi-layer paver machines and/or block production machines are not acceptable and shall be cause for rejection. Efflorescence must be minimized with the utilization of a water purification system.

G. Paver length and width shall not vary by more than (+/-) 1/16" (1.6mm) in unit dimension. Paver height shall not vary by more than (+/-) 1/8" (3.2mm) from specified standard dimensions.

H. Average absorption of 5% with no unit greater than 7% when tested in accordance with ASTM C-140 and resistance to 50 freeze-thaw cycles when tested in accordance with ASTM C-67.

I. Unit pavers from sources other than the specified manufacture must meet or exceed the specified manufacture's color loading. Color content to be certified by an independent testing facility. Color Pigments shall conform to ASTM C-979. Paver substitute samples, not manufactured by the specified source supplier, must be approved in writing by the District's Representative.

2.3 SAND LAYING COURSE

A. Sand laying course sharp and angular per ASTM C2488 and shall conform to ASTM C33 as follows:

Sieve Size	3/8 in.	No. 4	No. 8	No. 16	No. 30	No. 50	No. 100	No. 200
% passing	100	95-100	80-100	1-12	25-60	10-30	2-10	0-1

Permissible range of Salinity, Boron and Sodium as follows:
Salinity (millimoles per centimeter of saturated extract at 25 degrees C) = NIL - 3.0
Boron (saturation extract concentration) = NIL - 1.0 ppm
Sodium (sodium absorption ration-SAR) = NIL - 6.0 R

Re: CALTRANS Department of Transportation Specifications 90-3.03, Fine Aggregate Grading:

1. Thickness of sand laying course maximum 1" and uniform to ensure an even surface.
2. The sand laying course shall be the responsibility of the paving stone installer.

2.4 SAND JOINT FILLER

A. ASTM C-33. Use dry washed concrete sand for unit paver joint sand if conditions allow.

B. The following sand gradation may also be used if conditions do not allow use of washed concrete sand:

ASTM C-144 (Gradation for Alternate Joint Sand -"Mortar Sand")

Sieve Size:	No. 4	No. 8	No. 16	No. 30	No. 50	No. 100	No. 200
Passing:	100%	95-100%	70-100%	40-75%	20-40%	10-25%	0-10%

2.5 POLYMERIC SAND JOINT FILLER

A. Polymeric Joint Stabilizing Sand as recommended by concrete paver manufacturer.

2.6 WATERBASE SEALER

A. Shall be a Teflon-based or Epoxy-modified sealer as recommended by the paver manufacturer.

2.7 AGGREGATE BASE

A. Crushed aggregate, R-78 minimum, 3/4-inch maximum, conforming to CALTRANS Standard Specification 26.1.02A, Class 2.

2.8 STAIN AND EFFLORESCENCE REMOVERS

A. Refer to ICPI Tech Spec 5 Cleaning and Sealing Interlocking Concrete Pavement-a Maintenance and Protection Guide available at www.icpi.org . Another source is Removal of Stains From Concrete Surfaces available at www.nrc.ca/irc/cbd, publication CBD-153.

PART 3 - EXECUTION

3.1 SUBGRADE PREPARATION

A. Prepare subgrade in accordance with Section 31 20 00, Earthwork.

B. Prepare subgrade in accordance with Section 32 20 21, Subgrade Preparation & Base Material.

C. Prepare subgrade in accordance with Section 26 of the CALTRANS Standard Specifications, compacted to a minimum of 90% relative compaction.

D. Prepare subgrade in accordance with Structural Engineer's recommendations.

3.2 AGGREGATE BASE

A. Deliver to site as a uniform mixture and spread each layer in one operation without segregation.

B. Class II Aggregate Base, ¾" maximum size, shall be readily compacted and spread with equipment that will provide a uniform layer conforming to the planned section, and as specified in Section 26 of the CALTRANS Standard Specifications. Confirm that the aggregate base is as specified and to the required subgrade before beginning work.

3.3 SAND LAYING COURSE

A. Install dry sand to uniform depth required for flush finish after pavers are installed. The maximum designed depth shall be one inch thick with no sand thickness less than ¾" or more than 1 ½". Sand is to remain undisturbed prior to the installation of unit pavers. Moisture content of sand to remain constant.

3.4 PAVER INSTALLATION

A. Before installing, clean pavers of all foreign material. Remove any cement residue off pavers prior to installation. Do not begin installation of pavers until subgrade and base have been prepared per Specifications.

B. Screed sand bedding course to recommended depth. Sand is to remain undisturbed prior to the installation of unit pavers. Maintain constant sand moisture content.

C. Start installation from a corner or straight edge, unless detailed otherwise, and proceed forward over the undisturbed sand bedding course. Proceed forward over the undisturbed sand laying course with pavers as shown on Drawings. Cut pavers to conform to edges without gaps. Cut pavers to avoid thin slices. Cut pavers with a masonry saw, clean and uniform. Align paver bands to conform with plans.

D. Install pavers plumb and true to line and grade; to coincide and align with adjacent work and elevations in accordance with ICPI recommendations. Use string lines to hold pattern lines true. Maximum vertical deflection shall not exceed 3/8 inch under a 10-foot straightedge. All perimeter edges must be retained to secure the unit pavers and sand bedding course. Provide retainer as required. No unit paver joint shall be greater than 1/4" inch. No perimeter edge joint shall be greater than 3/8".

E. Cut unit pavers with a double-bladed stone cutter or diamond blade masonry saw.

F. Use a plate vibrator to compact the stones and to vibrate the sand up into the joints between the stones. A plate type vibrating compactor capable of 3,000 to 5,000 lbs. centrifugal compaction force should be used to compact the unit pavers into the sand bedding course. Two to three passes are recommended to insure an even elevation. Ensure paver surface is clear of debris prior to compaction. Do not use joint sand during this process. Avoid scuffing finished surface of pavers. Replace Scuffed pavers as directed by Owner's Representative.

G. Profiled Pavers shall be protected from scuffing during compaction using a woven geotextile such as Mirafi 500X or other method. Scuffed pavers shall be replaced as directed by Owner's Representative.

H. Spread specified sand over the installed and approved pavers and vibrate into the joints between the pavers. Make several passes with the plate compactor, while sweeping the sand into the paver joints. Ensure all joints are full before clean up. Excess sand should be swept up and removed from the completed unit paver installation.

I. The completed paving stone installation shall be swept and washed down to provide a clean, finished, workmanlike hardscape pavement.

J. The final surface elevation of pavers shall not deviate more than 3/8 in. under a 10 ft long straightedge.

K. The surface elevation of pavers shall be 1/8 to 1/4 inch above adjacent drainage inlets, concrete collars or channels.

L. Prior to applying Water-based Paver Sealer, remove any stains and efflorescence using cleaners specified in Part 2 of this specification. Apply Water-based Paver Sealer, per ICPI Tech Spec 5 and label instructions, after final cleanup and wash down of paving stone surface. During application, protect surrounding areas from over spray. All traffic, pedestrian or vehicular, shall be kept off of sealed pavers until initial cure time has been achieved.

3.5 CLEANUP, per Section 017400.

A. Perform the work under this Section so as to keep affected portions of the building and site neat, clean and orderly. Upon completion of the work under this Section, remove immediately all surplus materials, rubbish and equipment associated with or used in the performance of this work.

B. Reset all disturbed pavers and brush joints with sand.

END OF SECTION

SECTION 321443 - POROUS 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. Grass-planted porous pavement system.
   a. Subdrainage aggregate course.
2. Curbs and edge restraints.

B. Related Requirements:

1. Section 312000 "Earth Moving" for excavation and compacted subgrade.
2. Section 321313 "Concrete Paving" for cast-in-place concrete curbs that serve as edge restraints for porous paving.
3. Section 329300 "Plants" for planting ground cover in porous paving.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at **Project site**.

1.4 ACTION SUBMITTALS

A. Product Data:
   1. For the following:
      a. Pavers.
      b. Aggregates.
         1) Sand fill
         2) Gravel base
      c. Soil amendment and fertilizer.
      d. Grass seed.

B. Sieve Analyses: For aggregate materials, according to ASTM C136.

C. Samples:

1. Full-size units of each type of unit paver indicated.
2. Aggregate fill.
3. Aggregate setting bed materials.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

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 and fill materials.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for unit pavers, indicating compliance with requirements.

D. Manufacturer's Installation Instructions.

1.6 ACTION SUBMITTALS

1. Shop Drawings:
   a. Engineered cross section.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified porous unit paving installer certified by the manufacturer.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. 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 pavers on elevated platforms in a dry location in manufacturer's packaging. If units are not stored in an enclosed location, protect from sunlight.

B. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

PART 2 - PRODUCTS

2.1 GRASS-PLANTED POROUS PAVEMENT SYSTEM

A. Source Limitations: Obtain each type of paver from single source that has resources to provide materials and products of consistent quality in appearance and physical properties.

B. Basis of Design: Invisible Structures Grasspave2.
   1. Material: High density polyethylene – 100% recycled materials.
      a. Color: Black.
         1) UV stabilized.
   2. Dimensions:
      a. Roll width: 3.3 ft to 8.2 ft.
      b. Depth: 1 inch.
   3. Loading Capacity: 15,940 pounds per square inch when filled with sand.
   4. Tensile Strength: 458 pounds per inch ASTM D638.
   5. Permeability: 2.63 to 38.55 inches of water per hour.
   6. Effective Imperviousness: 10%.

2.2 CURBS AND EDGE RESTRAINTS

A. As indicated on drawings and in Section 321300 “Concrete Paving”.

2.3 AGGREGATE SETTING-BED MATERIALS

A. Graded Aggregate for Subbase: Sandy gravel material used for road base construction.
   1. Conforming to the following sieve analysis and requirements:
      a. 100 percent passing sieve size 1 inch (25 mm).
      b. 80-100 percent passing sieve size 3/4 inch (19 mm).
      c. 60-80 percent passing sieve size 3/8 inch (9 mm).
      d. 40-60 percent passing sieve size #4.
      e. 25-40 percent passing sieve size #10.
      f. 5-25 percent passing sieve size #40.
      g. 0-5 percent passing sieve size #200.

B. Sand for Filling: Sound, sharp, washed, natural sand complying with gradation requirements in ASTM C33/C33M for fine aggregate.
   1. Alternative: United States Golf Association (USGA) greens, section – sand mis “The Root Zone Mixture.”

C. Grass Seed: Comply with requirements in Section 329200 "Turf and Grasses."
   1. Provide mulch for hydroseeding or topsoil for seeding.

D. Turf Conditioner: Soil amendment and fertilizer supplied by manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Confirm subgrade compaction as indicated in drawings and as acceptable to manufacturer. Proceed with porous paver installation only after deficient subgrades have been corrected and are ready to receive base course for porous paving.
   1. Check for improperly compacted trenches, debris, and improper gradients.
   2. Confirm in-place soil is acceptably dry and free from standing water.
   3. Prior to installing base course for turf paving, obtain approval of local fire authorities of subgrade.

B. Start of installation constitutes acceptance of subgrade conditions and responsibility for satisfactory performance. If existing conditions are found to be unsatisfactory, notify the Owner in writing.

3.2 INSTALLATION, GENERAL

A. Do not use unit pavers with chips, cracks, voids, discolorations, and other defects that might be structurally unsound or visible in finished work.

B. Cut unit pavers with motor-driven masonry saw equipment[**or a block splitter**] 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.

C. Provide curbs as indicated. Install curbs before placing unit pavers.

3.3 INSTALLATION OF SETTING-BED

A. Compact subgrade uniformly to at least **95** percent of **ASTM D698** [**ASTM D1557**] laboratory density.

B. Proof-roll prepared subgrade to identify soft pockets and areas of excess yielding. 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. Place aggregate base, compact to 95 percent of ASTM D1557 maximum laboratory density, and screed to depth indicated.

1. Place engineered base in lifts not to exceed 6 inches, compacting each lift separately.

D. Leave 1 inch (2.5 centimeter) of depth below final grade for porous paver unit and sand fill and 0.5 inch (1.25 centimeter) for depth of topsoil germination area (if applicable).

3.4 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.

3.5 INSTALLATION OF TURF CONDITIONER

A. Spread all turf conditioner mix provided at manufacturer-recommended spreader rate evenly over the surface of the base course with a hand-held, or wheeled, rotary spreader.

B. The turf conditioner should be placed immediately before installing the porous unit paving.

3.6 INSTALLATION OF PAVERS

A. Set unit pavers on base, being careful not to disturb leveled base. Place units with rings facing up and use snap-fit connectors, pegs and holes to maintain proper spacing and interlocking of the units.

B. Units can be shaped with pruning shears or a knife.

C. Anchor units to the base course using stainless steel 40d nails with stainless steel fender washer.

D. Place units 0.25 to 0.5 inch (0.6 to 1.25 centimeters) below the surface of adjacent pavements.

E. Install sand in rings as they are laid in sections. Spread sand evenly into rings. Use a stiff-bristled broom for final even distribution. Consolidate and to fill rings by using water.

3.7 TURF INSTALLATION

A. The sand-filled rings must be covered by turf within one week. If paving system is left exposed, sand must be re-installed and leveled and paver materials

checked for integrity if rings become exposed due to wind, rain, traffic, or other factors.

A. Preferred method:
   1. Hydroseeding/hydro-mulching - Combine water, seed and fertilizer homogeneously in a purpose-built, truck-mounted tank. Spray the seed mixture onto the site at rates shown on plans and per hydroseeding manufacturer's recommendations. Coverage must be uniform and complete. Following germination of the seed, areas lacking germination larger than 8 inch x 8 inch (20 cm x 20 cm) must be reseeded immediately. Keep seeded areas must fertilized and moist during development of the turf plants. DO NOT DRIVE ON SYSTEM: Hydroseeded/hydro-mulch areas must be protected from any traffic, other than emergency vehicles, for 60 days, or until the root system has penetrated and established well below the paving units.
      a. A light "dusting" of commercial topsoil mix, not to exceed ½ inch (25 mm) can be placed above the rings and seed mix to aid germination rates.

B. Alternative:
   1. Install thin sod directly over sand filled rings. Sand shall be 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: Sodded areas must be protected from any traffic, other than emergency vehicles, for a period of 30 days, or until the root system has penetrated and established well below the paving units.

C. After filling pavers with soil, sow seed according to Section 329200 "Turf and Grasses," except sow seed at half the rate specified for seeding lawns. Sweep seed from surfaces of pavers into voids and water with fine spray.

   1. Within 24 hours after sowing seed, spread an additional 3/16 inch (4.8 mm) of uncompacted soil fill over seed and soak with water.

3.8 MAINTENANCE AND PROTECTION

A. Water newly planted grass and keep moist until grass is established. Maintain grass that is planted in paving to comply with requirements in Section 329200 "Turf and Grasses."

B. Erect barricades and warning signs as required to protect newly planted areas from traffic. Maintain barricades for **60** days after planting.

END OF SECTION 321443

SECTION 321542 – STABILIZED DECOMPOSED GRANITE

PART 1 - GENERAL

1.1 SUMMARY

A. Requirement of Products Covered Under This Section:
   1. Installation of Stabilized Decomposed granite paving surface as indicated on the drawings.

B. Related Sections:
   1. Section 32 93 00 "Landscape Planting" for Aluminum paving edges.

1.2 SUBMITTALS

A. Submit product data coincident with product samples.
   1. Product data: Submit product data for each gravel type to be provided, describing material, supplier, sieve analysis/size distribution and additional tests demonstrating compliance with the specification.
   2. Samples: Submit two 1-gallon bags of each gravel type showing conformance to selection and specified requirements.

B. Contractor shall furnish, if requested, signed copies of a compliance statement certifying that the copolymer complies with the specifications including weight per gallon, solids, pH, trade name of copolymer and gallons purchased.

1.3 QUALITY ASSURANCE

A. Source Quality Control:
   1. Obtain crushed granite or naturally occurring decomposed granite from single quarry as specified by this Section and as approved by Client Representative.

B. Installation:
   1. At no point shall the surface fail to drain.
   2. Copolymer treated decomposed granite can permanently stain concrete and other masonry surfaces. Protect adjacent pavement, curbs, etc. from contact. Remove any spillover immediately.

C. Mock-up:
   1. Provide mock-up in accordance with Section 014339.
   2. Construct approximately 6 square foot mock-up of mineral mulch surfacing illustrating complete system.
   3. Include setting method and paving.
   4. Approved mock-up may be incorporated into the Work of this Contract.
   5. Protect approved mock-ups as standard of quality for Work of this Section throughout duration of construction.

1.4 DELIVERY AND STORAGE OF MATERIALS

A. Packaged Materials: Deliver packaged materials in clearly marked containers showing net weight, guaranteed analysis and name of manufacturer. Specified requirements for packaged materials apply to bulk shipments. Protect materials from deterioration during delivery and during storage at site.

PART 2 PRODUCTS

2.1 DECOMPOSED GRANITE SURFACING

A. Mineral mulch: 3/8 inch minus crushed or decomposed granite.
   1. Color: Blue Path Fines, as approved by Landscape Architect. Available from Broadmoore Landscape (https://www.broadmoorlandscape.com/), Santa Barbara Sand (https://www.santabarbarasandandtopsoil.com/contact), or approved equal.
   2. Angular for stability, and graded so that material will firmly compact for use in creation of walking surfaces that meet ADA standards.
   3. The aggregate shall consist of hard, durable particles or fragments of crushed stone or gravel conforming to the following requirements and gradations:
      a. Abrasion, ASTM C131 and C535 50 percent max.*
      b. Fractured faces (one face) 95 percent max.*
      c. Fractured faces (two faces) 75 percent max.*
      d. Soundness loss, five cycles, ASTM C 88 (magnesium) 18 percent max.*
      e. Flat/elongated (length to width >5 ASTM D4791 15 percent max.*
      f. Based on the portion retained on the 3/8-inch sieve.
   4. Materials shall be free from organic material and lumps or balls of clay. Material passing the No. 4 sieve shall consist of natural or crushed sand and fine mineral particles.
   5. The material, including any blended filler, shall have a plasticity index of not more than 6 and a liquid limit of not more than 25 when tested in accordance with ASTM D4318.
   6. When two fractured faces are contiguous, the angle between the planes of fractures shall be at least 30 degrees to count as two fractured faces. Fractured faces shall be obtained by mechanical crushing. Gradation shall be obtained by crushing, screening, and blending processes as may be necessary. Material shall meet the following screen analysis requirements by weight.
   7. Gradation: Sieve Designation Percent Passing
      a. 5/8 inch 100
      b. 3/8 inch 90-95
      c. No. 4 75-85
      d. No. 8 60-75
      e. No. 16 45-60
      f. No. 30 25-35
      g. No. 50 15-25
      h. No. 100 10-18
      i. No. 200 3-12
   8. Aggregate shall contain a minimum of 5 percent clay particles but no more than 50 percent of that portion of material passing the No. 200 sieve size shall be clay.
   9. Inorganic clay to be used as binder shall conform to the following:
      a. Passing No. 200: 75 percent
      b. Liquid Limit: 30 min.
      c. Plastic Index: 8 min.
   10. The fraction of material passing the No. 200 sieve shall be determined by washing as indicated in ASTM D1140, "Amount of Material in Soils Finer than the No. 200 Sieve." The fractured faces for the coarse aggregate portion (retained on the No. 4 sieve) shall have an area of each face equal to at least 75 percent of the smallest midsectional area of the piece.

2.2 COPOLYMER

A. Basis of Design: Soilshield-LS polyvinyl acrylic copolymer colorless emulsion available from Soil-Loc, Inc., Scottsdale, Arizona, (888) 828-7300, or equal.

1. The stabilizing agent shall be a nonflammable concentrated polyvinyl acrylic copolymer with a formulation containing a minimum of 60% solids that may be diluted for application at job site.
2. After drying, the copolymer shall form a colorless, transparent micro-plastic like film to agglomerate particles and allow exchange of air and moisture.
3. The product shall have a minimum effective service life of at least two years, provided surface is maintained according to manufacturer's recommendations.
4. When cured, the copolymer emulsion shall not re-emulsify and shall be biodegradable and nontoxic to plant and animal life.
5. After application and drying, a core of the treated section shall be able to maintain a portion of its shape, elasticity, and a portion of its strength after being submerged in water for a 24-hour period.
6. Store material as recommended by manufacturer.

2.3 BASE COURSE

A. Base course to match Standard Base Course as used under concrete paving.

2.4 GEOTEXTILE SOIL SEPARATION FABRIC

A. Geosynthetic Reinforcement:
   1. Mirafi 140N, available from TenCate Mirafi® 706-693-2226 or toll free 800-685-9990 or equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Preparation:
   1. Examine subgrade and base course installed conditions for improperly compacted trenches, debris, and improper gradients. Do not start decomposed granite surfacing installation until unsatisfactory conditions are corrected.
   2. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance. If existing conditions are found unsatisfactory, contact the Client Representative for resolution. Ensure that subgrades are compacted as indicated.
B. Reinforcement below decomposed granite in existing soil: Install geosynthetic reinforcement over existing soil per manufacturer's recommendations.
C. Placing:
   1. Install Base Course as shown, to the thickness shown on the drawings and gently hand-tamp.
   2. Place the decomposed granite over the prepared base rock as shown, to the thickness shown on the Drawings.
   3. Distribute the material in a uniform layer. The layer shall be such size that when spread and compacted, the layer shall have the required thickness.
   4. Spread the material smoothly to a uniform thickness to the elevations indicated on the Drawings.
   5. Install material at 15-30% above final grade to account for compaction loss.
   6. Level material.
D. Compacting:
   1. Compact to 90%. Compaction can be achieved with 4-8 longitudinal overlapping passes (plate compactor) or 2-3 passes with a double drum roller.
   2. Test compaction and avoid over-compaction.
   3. Correct any irregularities or depressions that develop.

4. Add or remove material until the surface is smooth and uniform.

E. Apply copolymer evenly and uniformly to the loose, screeded material using approved sprayer at the rate recommended below.

3" Decomposed Granite Depth Stabilization
One (1) gallon concentrate per 80 square feet diluted with 20 parts water.

F. Apply solution slowly enough to ensure full penetration. Repeat applications until solution has percolated full depth of decomposed granite material to be stabilized. Rake and till as required between sprayed applications to thoroughly mix the solution evenly throughout the decomposed granite material. Verify full penetration of copolymer by hand sampling prior to compaction.

G. Allow material to dry to compactable consistency (optimum moisture) and roll and compact with 1 – 3 ton roller or vibratory plate compactor to 90 percent relative compaction.

H. Do not allow stabilizer treated DG to contact adjacent pavements or other surfaces. Provide protection of adjacent surfaces with plastic or other materials to prevent staining. Remove any stabilized DG from adjacent surfaces immediately upon discovery and correct any stain damage.

I. After the pavement has cured for a minimum of 72 hours, remove excess material and dress the shoulders of the pavement. Fill low shoulders and fine grade as required and accepted by the Client Representative. Saw cut, remove and replace any unacceptable pavement as approved by Client Representative.

J. Tolerances:
   1. Gravel adjacent to walkway: The finished grade of the completed course shall not vary more than 1/4-inch plus or minus from the finished grade shown on the Drawings.
   2. Other areas: The finished grade of the completed course shall not vary more than 1/2-inch from the finished grade shown on the Drawings.

END OF SECTION

SECTION 32 17 23.13 - PAINTED PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 SUMMARY

A. All striping and pavement markings shall be located per plans.

B. All construction shall conform to the *Standard Specifications for Public Works Construction*, latest edition.

1.2 REFERENCES

A. *Standard Specifications for Public Works Construction (SSPWC)*, latest edition.

B. *Federal Standard 595B* - Colors Used in Government Procurement.

C. *California Building Code (CBC)*, latest edition.

D. *State of California Department of Transportation Standard Specifications (SSS)*, Caltrans, latest edition.

PART 2 - MATERIALS

2.1 FIELD QUALITY CONTROL

A. All paint and related materials shall conform to Section 214-4 of the SSPWC.

B. Painting and striping of the accessible parking stalls shall conform to Section 214 of the SSPWC and the plans.

PART 3 - EXECUTION

3.1 PREPARATION

A. Painted lines and markings on pavement shall be 4-inch minimum wide and color as indicated on plans.

3.2 FIELD QUALITY CONTROL

A. All pavement striping and markings shall conform to Section 314-4 of the SSPWC.

END OF SECTION

SECTION 32 17 26 – DETECTABLE WARNING SURFACING

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install Cast-in-Place or Surface Applied Detectable Warning Surfaces with truncated domes at pedestrian crossings, curb ramps, boarding platforms, or rail crossings.

1.2 REFERENCES

A. California Building Code (CBC), latest edition.

1.3 RELATED DOCUMENTS

A. Compliance with Contract Documents, General Conditions, and Division 1 Specifications.

1.4 SUBMITTALS

A. Product Data: Manufacturer literature detailing installation, maintenance, and compliance.

B. Samples: One 12" x 12" tile sample for verification.

C. Material Test Reports: Independent lab reports confirming compliance with ASTM, ADA, and FM standards.

D. Warranty: Submit post-installation warranties in the Owner's name.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Approved Products: Armor Tile (Engineered Plastics Inc.), ADA Solutions Cast-In-Place Replaceable (CIP REP), or approved equivalents.

2.2 MATERIALS

A. All materials must comply with CBC section 11B-705.1.

B. Composition:

1. Cast-in-Place: Vitrified Polymer Composite (VPC) with fiberglass reinforcement, UV-resistant epoxy.
2. Surface Applied: Glass/carbon-reinforced polyester SMC composite with matte finish.

C. Dome Specifications:
1. Size: Base diameter 0.9–1.4", top diameter 50–65% of base, height 0.2".
2. Spacing: Center-to-center 1.6–2.4", base-to-base ≥0.65".
3. Pattern: Square or radial grid alignment

D. Color: Confirm color with landscape architect prior to ordering and installation.

2.3 PERFORMANCE

A. Compressive Strength: ≥28,900 psi (ASTM D695).

B. Slip Resistance: Static coefficient ≥1.18 (dry) / ≥1.05 (wet) (ASTM C1028).

C. Abrasion Resistance: ≤0.03 cm^3 volume loss (FM 5-594).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Preparation: Ensure substrate is clean, level, and cured.

B. Placement:
1. Extend 24" minimum in travel direction, full width of curb ramp or landing.
2. Align domes per grid pattern, maintaining ADA-compliant spacing.

C. Fasteners: Use manufacturer-supplied anchors/adhesives for secure attachment.

D. Curing: Protect tiles during concrete setting; follow manufacturer's guidelines.

3.2 QUALITY CONTROL

A. Verify visual contrast with adjacent surfaces (light-on-dark or dark-on-light).

B. Inspect for defects, alignment, and slip resistance post-installation.

3.3 MAINTENANCE

A. Clean with non-abrasive methods; avoid harsh chemicals.

END OF SECTION

SECTION 323113 - CHAIN LINK 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. Chain-link fences.
      a. Vinyl coated
   2. Swing gates.
B. Related Requirements:
   1. Section 033000 "Cast-in-Place Concrete" for cast-in-place concrete and post footings.

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 coordination of interlocked equipment specified in this Section and elsewhere.
   3. Review required testing, inspecting, and certifying procedures.

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 the following:
      a. Fence and gate posts, rails, and fittings.
      b. Chain-link fabric, reinforcements, and attachments.
      c. Gates and hardware.
B. Shop Drawings: For each type of fence and gate assembly.
   1. Include plans, elevations, sections, details, and attachments to other work.
   2. Include accessories, hardware, gate operation, and operational clearances.
   3. Wiring Diagrams: For power, signal, and control wiring.
C. Samples for Initial Selection: For each type of factory-applied finish.
D. Samples for Verification: For each type of component with factory-applied finish, prepared on Samples of size indicated below:
   1. Polymer-Coated Components: In 6-inch lengths for components and on full-sized units for accessories.
E. Delegated-Design Submittal: For structural performance of chain-link fence and gate frameworks, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer.
B. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

1.7 QUALITY ASSURANCE

A. Mockups: Build mockups to set quality standards for fabrication and installation.
1. Build mockup for typical chain-link fence and gate, including accessories.
a. Size: 10-foot length of fence.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

1.9 WARRANTY

A. Special Warranty: Installer agrees to repair or replace components of chain-link fences and gates that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
a. Failure to comply with performance requirements.
b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 VINYL COATED CHAIN-LINK FENCE FABRIC

A. General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist according to "CLFMI Product Manual" and requirements indicated below:
1. Fabric Height:
a. 8' tall.
2. Steel Wire for Fabric: Wire diameter of 0.148 inch.
a. Mesh Size: 2 inches.
b. Polymer-Coated Fabric: ASTM F 668, Class 1 over zinc -coated steel wire.
1) Color: Green, according to ASTM F 934.
c. Coat selvage ends of metallic-coated fabric before the weaving process with manufacturer's standard clear protective coating.
3. Selvage: Knuckled at both selvages.

2.2 FENCE FRAMEWORK

A. Posts and Rails: ASTM F 1043 for framework, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F 1043 based on the following:

1. Fence Height: As indicated on Drawings.
2. Light-Industrial-Strength Material: Group IC-L, round steel pipe, electric-resistance-welded pipe.
    a. Line Post: 2.375 inches in diameter.
    a. End, Corner, and Pull Posts: 2.375 inches.
3. Horizontal Framework Members: Intermediate top rails according to ASTM F 1043.
    a. Top Rail: 1.66 inches in diameter.
4. Brace Rails: ASTM F 1043.
5. Polymer coating over metallic coating.
    a. Color: Match chain-link fabric, according to ASTM F 934.

2.3 TENSION WIRE

A. Polymer-Coated Steel Wire: 0.148-inch- diameter, tension wire according to ASTM F 1664, Class 1 over zinc -coated steel wire.
    1. Color: Match chain-link fabric, according to ASTM F 934.

2.4 SWING GATES

A. General: ASTM F 900 for gate posts and double swing gate types.
    1. Gate Leaf Width: As indicated.
    2. Framework Member Sizes and Strength: Based on gate fabric height as indicated.
B. Pipe and Tubing: ASTM F900 for gate posts and double swing gate types.
    1. Zinc-Coated Steel: ASTM F 1043 and ASTM F 1083; protective coating and finish to match fence framework.
    2. Gate Posts: Round tubular steel.
    3. Gate Frames and Bracing: Round tubular steel.
C. Frame Corner Construction: welded and treated with zinc-rich paint.
D. Hardware:
    1. Hinges:
        a. Accessible Gates: 90-degree in and out swing.
        b. Maintenance Gates: 180-degree outward swing.
    2. Latch: Permitting operation from both sides of gate with provision for padlocking accessible from both sides of gate.
    3. Lock: None.
    4. Padlock and Chain: None.
    5. Closer: None.
    6. Stop: None, see Latch.
    7. Keeper: For each gate leaf over 5 feet wide.
    8. Cane bolt: At double leaf gates, inactive leaf. Provide at closed and open position.

2.5 FITTINGS

A. Provide fittings according to ASTM F 626.
    1. Post Caps: Provide for each post.
        a. Provide line post caps with loop to receive tension wire or top rail.
    2. Rail and Brace Ends: For each gate, corner, pull, and end post.
    3. Rail Fittings: Provide the following:
        a. Top Rail Sleeves: Pressed-steel or round-steel tubing not less than 6 inches long.

b. Rail Clamps: Line and corner boulevard clamps for connecting intermediate and bottom rails to posts.

4. Tension and Brace Bands: Galvanized pressed steel.

5. Tension Bars: length not less than 2 inches shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.

6. Tie Wires, Clips, and Fasteners: According to ASTM F 626.

a. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, according to the following:

1) Hot-Dip Galvanized Steel: 0.148-inch- diameter wire.

2) Aluminum: ASTM B 211; Alloy 1350-H19; 0.148-inch- diameter, mill-finished wire.

B. Finish:

1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz./sq. ft. of zinc.

a. Polymer coating over metallic coating.

2. Aluminum: Mill finish.

2.6 GROUT AND ANCHORING CEMENT

A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout, recommended in writing by manufacturer, for exterior applications.

B. 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. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating, and that is recommended in writing by manufacturer for exterior applications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for a certified survey of property lines and legal boundaries, site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.

1. Do not begin installation before final grading is completed unless otherwise permitted by Architect.

B. 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.

3.3 CHAIN-LINK FENCE INSTALLATION

A. Install chain-link fencing according to ASTM F 567 and more stringent requirements specified.

1. Install fencing on established boundary lines inside property line.

B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.
C. 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 to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
        a. Concealed Concrete: Place top of concrete below grade to allow covering with surface material where occurs, coordinate with depth of material.
            1) Where installed with concrete mow-curb, provide rebar hooks in post footing to embed in subsequent mow-strip pour.
D. Terminal Posts: Install terminal end, corner, and gate posts according to ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment of as indicated on Drawings. For runs exceeding 500 feet, space pull posts an equal distance between corner or end posts.
E. Line Posts: Space line posts uniformly at 96 inches o.c.
F. Post Bracing and Intermediate Rails: Install according to ASTM F 567, maintaining plumb position and alignment of fence posts. Diagonally brace terminal posts to adjacent line posts with truss rods and turnbuckles. Install braces at end and gate posts and at both sides of corner and pull posts.
    1. Locate horizontal braces at midheight of fabric 72 inches or higher, on fences with top rail, and at two-third fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.
G. Tension Wire: Install according to ASTM F 567, maintaining plumb position and alignment of fence posts. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch-diameter hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches o.c. Install tension wire in locations indicated before stretching fabric. Provide horizontal tension wire at the following locations:
    1. As indicated on Drawings.
H. Top Rail: Install according to ASTM F 567, maintaining plumb position and alignment of fence posts. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.
I. Intermediate and Bottom Rails: Secure to posts with fittings.
J. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 1-inch bottom clearance between finish grade or surface and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.
K. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts, with tension bands spaced not more than 15 inches o.c.
L. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric according to ASTM F 626. Bend ends of wire to minimize hazard to individuals and clothing.
    1. Maximum Spacing: Tie fabric to line posts at 12 inches o.c. and to braces at 24 inches o.c.
M. Fasteners: Install nuts for tension bands and carriage bolts on the side of fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

N. Privacy Slats: Install slats in direction indicated, securely locked in place.

3.4 GATE INSTALLATION

A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation.

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 323113

SECTION 323118- SITE HANDRAILS AND RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Stainless Steel railings.

B. Related Sections:
   1. Division 03 Section "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 05 60 00 "Landscape Metal Fabrications".
   3. Division 09 Section "High Performance Coatings" for shop primers to be applied on materials specified in this section and coatings to be applied over shop primers.
   4. Section 32 33 00 "Site Furnishings" for Anti-Skate Deterrent.

1.2 DEFINITIONS

A. Railings: Guards, handrails, and similar devices used for protection of occupants at open-sided floor areas, pedestrian guidance and support, visual separation, or wall protection.

1.3 PERFORMANCE REQUIREMENTS

A. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
   1. Steel: 72 percent of minimum yield strength.

B. Structural Performance: 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. (0.73 kN/m) applied in any direction.
      b. Concentrated load of 200 lbf (0.89 kN) 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 (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
      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 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 (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:
1. Manufacturer's product lines of metal railings assembled from standard components.
2. Grout, anchoring cement, and paint products.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

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.

1.5 INFORMATIONAL SUBMITTALS

A. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.

B. Welding certificates.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of railing from single source from single manufacturer.

B. 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.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.6, "Structural Welding Code - Stainless Steel."

D. Preinstallation Conference: Conduct conference at Project site .

1.7 PROJECT 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.
1. Provide allowance for trimming and fitting at site.

1.8 COORDINATION AND SCHEDULING

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 suit structural performance requirements.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes. Treat to prevent corrosion from moisture and salt air.

B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.

2.2 STEEL AND IRON

A. Tubing: ASTM A554, Grade MT 304, stainless steel, structural tubing for ornamental applications.

B. Bars and Plates: ASTM A276, Type 304 stainless steel.

C. Shapes: ASTM A240/A240M, Type 304 stainless steel sheet or plate.

2.3 FASTENERS

A. Fastener Materials: Unless otherwise indicated, provide the following:
1. Aluminum Components: Type 304 stainless-steel fasteners.
2. Stainless-Steel Components: Type 304 stainless-steel fasteners.
3. Exterior Stainless-Steel Components: Type 316 stainless-steel fasteners.
4. Galvanized-Steel Components: Plated-steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating.
5. Dissimilar Metals: Type 304 stainless-steel fasteners.
6. Avoid dissimilar metals in contact with stainless steel to prevent galvanic corrosion.

B. Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated.

C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless exposed fasteners are the standard fastening method for railings indicated.
1. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

E. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
1. 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).

F. Cast-in-place anchors: designed for attachment to concrete forms.
1. Threaded type stainless steel ASTM A 743/A 743M, Grade CF 8M or CF 3M.castings

2.4 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. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with welded connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds: no evidence of a welded joint.

I. Form changes in direction as follows:
1. As detailed.

2.5 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 shipment.

C. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

D. Coat all exposed metal to prevent corrosion and rust from moisture and salt air.

PART 3 - EXECUTION

3.1 COORDINATION

A. Coordinate installation of steel pipe sleeves and wall backing for rail support as required.

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 (2 mm in 1 m).
   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 (5 mm in 3 m).

C. Corrosion Protection: 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.

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.

3.4 ANCHORING POSTS

A. Form or core-drill holes not less than 5 inches (125 mm) deep and diameter of 1.5 x the largest dimension 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, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Cover anchorage joint with flange (“escutcheon”) of same metal as post as indicated, welded to post after placing anchoring material .

C. Install removable railing sections, where indicated, over slip-fit metal posts cast in concrete as indicated.

3.5 CLEANING

A. Clean stainless steel by washing thoroughly with clean water and soap, rinsing with clean water, and wiping dry.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.6 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION

SECTION 323119- DECORATIVE METAL FENCES

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.

1.1 SUMMARY

A. Section Includes:
   1. Decorative steel fences.
   2. Swing gates.
B. Related sections:
   1. Section 085413 "Door Hardware" for hardware including:
      a. Exit devices
      b. Kick plates

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 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.

   Include diagrams for wiring for electronic security devices.

C. Samples: For each fence material and for each color specified.

   1. Provide Samples 12 inches (300 mm) in length for linear materials.
   2. Provide Samples 12 inches (300 mm) square for bar grating and sheet or plate materials.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For gate operators to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Lightning-Protection System: Maximum grounding-resistance value of 25 ohms under normal dry conditions.

2.2 DECORATIVE METAL FENCES

A. Fences made from steel tubing bars and shapes, finishes as noted below.

B. Decorative welded wire fence: WireWorks Plus by Ameristar Perimeter Security (800-321-8724) or approved equal

1. Heights as shown on drawings.

C. Posts: Square steel tubing. Provide end caps welded to top of posts.

1. Panels and posts shall be precut to specified lengths. Panels shall have a number of structural folds based on the specified panel height as follows:

a. 48" height x 96" width panel – 2 horizontal panel folds

b. 60" height x 96" width panel – 2 horizontal panel folds

c. 69" height x 96" width panel – 3 horizontal panel folds

d. 96" height x 96" width panel – 4 horizontal panel folds

2. The manufactured panels and posts shall be subjected to high-temperature, in-line, multi-stage, multi-layer coating process including, as a minimum, a six-stage pretreatment/wash, an electrostatic spray application of an epoxy base, and a separate electrostatic spray application of a polyester finish. The base coat shall be a thermosetting epoxy powder coating (gray in color) with a minimum thickness of 2 mils (0.0508mm). The topcoat shall be a "no-mar" TGIC polyester powder coat finish with a minimum thickness of 2 mils (0.0508mm). The color shall be Black.

D. Fasteners: per manufacturer instructions.

E. Finish exposed welds to comply with NOMMA Guideline 1, Finish #2 - completely sanded joint, some undercutting and pinholes okay.

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 03 30 00 "Cast-in-Place Concrete" with a minimum 28-day compressive strength of 3000 psi (20 MPa), 3-inch (75-mm) slump, and 1-inch (25-mm) 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 GROUNDING MATERIALS

A. Grounding Conductors: Bare, solid wire for No. 6 AWG and smaller; stranded wire for No. 4 AWG and larger.

1. Material above Finished Grade: Copper or Aluminum.
2. Material on or below Finished Grade: Copper.
3. Bonding Jumpers: Braided copper tape, 1 inch (25 mm) wide, woven of No. 30 AWG bare copper wire, terminated with copper ferrules.

B. Grounding Connectors and Grounding Rods: Comply with UL 467.

1. Connectors for Below-Grade Use: Exothermic-welded type.
2. Grounding Rods: Copper-clad steel.

a. Size: 5/8 by 96 inches (16 by 2440 mm).

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 (152.5 m) or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

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.

3.4 GROUNDING AND BONDING

A. Fence Grounding: Install at maximum intervals of 1500 feet (450 m) except as follows:

1. Fences within 100 Feet (30 m) of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 750 feet (225 m).

a. Gates and Other Fence Openings: Ground fence on each side of opening.

1) Bond metal gates to gate posts.
2) Bond across openings, with and without gates, except at openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches (460 mm) below finished grade.

B. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at a maximum distance of 150 feet (45 m) on each side of crossing.

C. Fences Enclosing Electrical Power Distribution Equipment: Ground as required by IEEE C2 unless otherwise indicated.

D. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches (150 mm) below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at grounding location.

E. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.

F. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
2. Make connections with clean, bare metal at points of contact.

3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

G. Bonding to Lightning-Protection System: If fence terminates at lightning-protected building or structure, ground the fence and bond the fence grounding conductor to lightning-protection down conductor or lightning-protection grounding conductor, complying with NFPA 780.

3.5 DEMONSTRATION

A. Train Owner's personnel to adjust, operate, and maintain gates.

END OF SECTION

SECTION 323300 - SITE FURNISHINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Anti-Skate Deterrents.
2. Bicycle racks.
3. Benches.
4. Attachments for site furnishings described in this spec, and site-built furnishings as shown on drawings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.
1. Samples for Initial Selection: For units with factory-applied finishes.
2. Samples for Verification: For each type of exposed finish, not less than 6-inch-long linear components and 4-inch-square sheet components.

C. Product Schedule: For site furnishings. Use same designations indicated on Drawings.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For site furnishings to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 ANTI-SKATE DETERRENTS

A. Anti-Skate Deterrent on Handrails:
1. Manufacturer: Park Warehouse or approved equal.
2. Phone: 888-321-5334
3. Model: Aluminum Skateboard Deterrent, SKU: ANTISKATE1011
4. Material: Cast Aluminum.
5. Locations: Upper portion of handrails at 3'-0" o.c. max., only where approved by DSA.

6. Accessibility Compliance: Anti-skate deterrents shall not be installed on any handrail or guardrail that is part of an accessible route or required to comply with CBC/ADA handrail requirements. Locations are subject to DSA review and approval.

B. Anti-skate Deterrent on Concrete Site Walls:
1. Manufacturer: Park Warehouse or approved equal.
2. Phone: 888-321-5334
3. Model: Hemi Shaped Grinder Minders
4. Material: Stainless Steel
5. Finish: Black Oxide Finish (soft matte black appearance)
6. Locations: top of concrete walls at 3'o.c. max.

2.2 BIKE RACKS

A. Bike Rack:
1. Manufacturer: Palmer Group, LLC or approved equal.
2. Phone: 415-335-0626
3. Model: Welle Circular Rack.
4. Material: 304 Stainless Steel.
5. Mount: Surface mount.
6. Location: Refer to Landscape Drawings.
7. Quantities: (8).

2.3 BENCHES

A. Outdoor Bench with Backrest
1. Manufacturer: Landscape Forms or approved equal.
Phone: 800-521-2546
2. Model: Neoliviano Bench or equal.
3. Material: Cast Aluminum.
4. Finish: Anodized Finish.
5. Wood Type: Domestically Sourced Thermally Modified Ash.
6. Size: 26.5" Deep, 69" Wide, 31" High.
7. Mount: Benches must be embedded. Each support has two threaded rods about 4" below grade.
8. Quantities: (1)

2.4 MATERIALS

A. Anchors, Fasteners, Fittings, and Hardware: Stainless steel; commercial quality, tamperproof, vandal and theft resistant, concealed, recessed, and capped or plugged.

B. 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.

2.5 FABRICATION

A. Metal Components: Separate metals from dissimilar materials to prevent electrolytic action.

B. Factory Assembly: Assemble components in the factory to greatest extent possible to minimize field assembly. Clearly mark units for assembly in the field.

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.

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, GENERAL

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.

END OF SECTION

SECTION 32 39 13 – MANUFACTURED BOLLARDS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes materials and installation requirements for fixed and removable bollards for vehicle and pedestrian protection.

1.2 DESCRIPTION

A. Furnish and install Cast-in-Place or Surface Applied Detectable Warning Surfaces with truncated domes at pedestrian crossings, curb ramps, boarding platforms, or rail crossings.

1.3 SUBMITTALS

A. Product Data: Manufacturer's specifications, installation instructions, and maintenance recommendations.

B. Shop Drawings: Indicate locations, sizes, foundations, and attachment details.

C. Samples: Color samples of finishes for selection.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's unopened containers with labels intact.

B. Protect finishes from damage during handling and installation.

1.5 WARRANTY

A. Provide manufacturer's standard warranty for a minimum of one year from date of substantial completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel Pipe: ASTM A53, Schedule 40 or as indicated.

B. Structural Steel: ASTM A36 where applicable.

C. Concrete: 2,500 psi compressive strength minimum.

D. Anchors and Fasteners: Stainless steel, ASTM F593/F594.

E. Finish: Hot-dip galvanized per ASTM A123, with powder coat finish in color selected by Architect.

2.2 FIXED BOLLARDS

A. Manufactured by Traffic Guard, Model RFP3560R. Dark Bronze Color, RAL color TBD, matte finish.

B. Type: Embedded, steel pipe filled with concrete.

C. Dimensions: as indicated on plans.

D. Height: 36 inches above finish grade.

E. Cap: Welded steel cap, smooth finish.

F. Installation: Centered vertically, encased in concrete footing as shown on plans.

2.3 REMOVABLE BOLLARDS

A. Manufactured by Traffic Guard, Model HL2004 or approved equal.
   1. Dark Bronze color where shown on plans, RAL color TBD, matte finish.
   2. Yellow color where shown on plans, RAL1028 Yellow, standard finish.

B. Type: Lockable, sleeve-mounted bollard with concealed fastening.

C. Sleeve: Galvanized steel or aluminum receiver, set in concrete.

D. Locking Mechanism: Helix Lock system as specified by manufacturer.

E. Cap: Weather-sealed cap for sleeve when bollard removed.

F. Dimensions: as indicated on plans.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify locations of underground utilities before excavation.

B. Confirm site conditions are suitable prior to installation.

3.2 INSTALLATION – FIXED BOLLARDS

A. Excavate to required depth and dimensions.

B. Set bollards vertically and plumb; backfill with concrete foundation per plans, ensuring full embedment.

C. Finish tops smooth; ensure bollards are uniform in alignment.

3.3 INSTALLATION – REMOVABLE BOLLARDS

A. Install receiver sleeves plumb and level; set tops flush with finished grade.

B. Fill surrounding excavation with reinforced concrete foundation per plans.

C. After curing, install bollards and secure locking mechanism.

3.4 CLEANING AND PROTECTION

A. Remove construction debris and excess materials.

B. Repair or replace damaged finishes.

C. Protect installed bollards from impact during adjacent construction

END OF SECTION

SECTION 328400 - LANDSCAPE IRRIGATION

PART 1 - GENERAL

1.1 SUMMARY

A. It is the intent of the specifications and drawings that the finished system is complete in every respect and shall be ready for operation satisfactory to the Architect.

B. The work shall include all materials, labor, services, transportation, and equipment necessary to perform the work as indicated on the drawings, in these specifications, and as necessary to complete the contract.

C. Secure the required licenses and permits including payments of charges and fees, give required notices to public authorities and verify permits secured or arrangements made by others affecting the work of this section.

1.2 CONSTRUCTION DRAWINGS

A. Offsets, fittings, sleeves, etc. which may be required are not shown on the drawings. Carefully investigate the structural and finished conditions affecting the work and plan the work accordingly, furnishing such fittings, etc. as may be required to meet such conditions. The work shall be installed in such a manner as to avoid conflicts between irrigation systems, planting, and architectural features.

B. Work called for on the drawings by notes or details shall be furnished and installed whether or not specifically mentioned in the specifications. When an item is shown on the plans but not shown on the specifications or vice versa, it shall be deemed to be as shown on both. The Architect shall have final authority for clarification.

C. Do not willfully install the irrigation system as shown on the drawings when it is obvious in the field that obstructions, grade differences or discrepancies in area dimensions exist that might not have been considered in engineering. Such obstructions or differences should be brought to the attention of the Architect as soon as detected. In the event this notification is not performed, the Contractor shall assume full responsibility for any revision necessary.

1.3 QUALITY ASSURANCE

A. Provide at least one English speaking person who shall be present at all times during execution of this portion of the work and who shall be thoroughly familiar with the type of materials being installed and the manufacturer's recommended methods of installation and who shall direct all work performed under this section.

B. Manufacturer's directions and detailed drawings shall be followed in all cases where the manufacturer of articles used in this contract furnish directions covering points not shown in the drawings and specifications.

C. All local, municipal, and state laws, rules and regulations governing or relating to any portion of this work are hereby incorporated into and made a part of these

specifications, and their provisions shall be carried out by the Contractor. Anything contained in these specifications shall not be construed to conflict with any of the above rules and regulations of the same. However, when these specifications and drawings call for or describe materials, workmanship, or construction of a better quality, higher standard, or larger size than is required by the above rules and regulations, the provisions of these specifications and drawings shall take precedence.

D. All materials supplied for this project shall be new and free from any defects. All defective materials shall be replaced immediately at no additional cost to Owner.

1.4 SUBMITTALS

A. Water Pressure Test:
   1. After award of contract and before any irrigation system materials are ordered from suppliers or delivered to the job site, submit to the Owner a written verification of the existing water pressure on the project at each of the points of connection shown.
   2. The water pressure test shall be performed to measure the dynamic water pressure at the point of connection at the maximum flow rate of the proposed irrigation system as shown on the point of connection note. Dynamic water pressure is when water is flowing through the point of connection. Static water pressure readings when water is not flowing, are not acceptable.
   3. Written dynamic water pressure test confirmation shall be made on the contractor's letterhead and include the flow rate during the test, the recorded water pressure, the date of the test and the time of the test.

B. Material List:
   1. After award of contract and before any irrigation system materials are ordered from suppliers or delivered to the job site, submit to the Owner a complete list of all irrigation system materials, or processes proposed to be furnished and installed as part of this contract.
   2. The submittal materials list shall include the following information:
      a. A title sheet with the job name, the contractor's name, contractor's address and telephone number, submittal date and submittal number.
      b. An index sheet showing the item number (e.g. 1,2,3, etc.); an item description (e.g. sprinkler head); the manufacturer's name (e.g. Hunter Industries); the item model number (e.g. I-40-ADV/36V); and the page(s) in the submittal set that contain the catalog cuts.
      c. The catalog cuts shall be one or two pages copied from the most recent manufacturer's catalog that indicate the product submitted. Do not submit parts lists, exploded diagrams, price lists or other extra information.
      d. The catalog cuts shall clearly indicate the manufacturer's name and the item model number. The item model number, all specified options and specified sizes shall be circled on the catalog cuts.
      e. Submittals for equipment indicated on the legend without manufacturer names, or "as approved", shall contain the manufacturer, Class or Schedule, ASTM numbers and/or other certifications as indicated in these specifications.
   3. Submittal materials list format requirements:

a. Submittals shall be provided as one complete package for the project in electronic pdf format. Multiple partial submittals will not be reviewed.
b. Submittal package shall have all pages numbered in the lower right hand corner. Page numbers shall correspond with submittal index.
c. Re-submitted packages must be revised to include only the equipment being re-submitted. Equipment previously reviewed and accepted shall not be re-submitted in the materials list/index sheet or in the catalog cut sheet package.

C. Substitutions: If the Contractor wishes to substitute any equipment or materials for those equipment or materials listed on the irrigation drawings and specifications, he may do so by providing the following information to the Architect for approval.
1. Provide a written statement indicating the reason for making the substitution.
2. Provide catalog cut sheets, technical data, and performance information for each substitute item.
3. Provide in writing the difference in installed price if the item is accepted.

D. The Landscape Architect or Owner's authorized representative will allow no substitutions without prior written acceptance

E. No substitutions of pump manufacturers, distributors or assemblies will be accepted.

F. Manufacturer's warranties shall not relieve the Contractor of his liability under the guarantee. Such warranties shall only supplement the guarantee.

G. The Architect will not review the submittal package unless provided in the format described above.

1.5 INSPECTIONS

A. The Contractor shall permit the Landscape Architect and Owner's authorized representative to visit and inspect at all times any part of the work and shall provide safe access for such visits.

B. Where the specifications require work to be tested by the Contractor, it shall not be covered over until accepted by the Landscape Architect, Owner's authorized representative, and/or governing agencies. The Contractor shall be solely responsible for notifying the Landscape Architect, Owner, and governing agencies, a minimum of 48 hours in advance, where and when the work is ready for testing. Should any work be covered without testing or acceptance, it shall be, if so ordered, uncovered at the Contractor's expense.

C. Inspections will be required for the following at a minimum:
1. Pre-construction meeting.
2. System layout.
3. Pressure test of irrigation mainline (Four hours at 125 PSI or 120% of static water pressure, whichever is greater.) Mainline pressure loss during test shall not exceed 2 PSI.
4. Coverage test of irrigation system. Test shall be performed prior to any planting.
5. Final inspection prior to start of maintenance period.
6. Final acceptance prior to turnover.

D. Site observations and testing will not commence without the field record drawings as prepared by the Irrigation Contractor. Record drawings must be complete and up to date for each site visit.

E. Work that fails testing and is not accepted will be retested. Hourly rates and expenses of the Landscape Architect, Owner's authorized representative, and governing agencies for re-inspection or retesting will be paid by the Irrigation Contractor at no additional expense to Owner.

1.6 EXISTING CONDITIONS

A. Verify and be familiar with the locations, size and detail of points of connection provided as the source of water, electrical supply, and ethernet connection to the irrigation system.

B. Irrigation design is based on the available static water pressure shown on the drawings. Contractor shall verify static water on the project prior to the start of construction. Should a discrepancy exist, notify the Landscape Architect and Owner's authorized representative prior to beginning construction.

C. Prior to cutting into the soil, locate all cables, conduits, sewer septic tanks, and other utilities as are commonly encountered underground, and take proper precautions not to damage or disturb such improvements. If a conflict exists between such obstacles and the proposed work, the Contractor shall promptly notify the Landscape Architect and Owner who will arrange for relocations. The Contractor will proceed in the same manner if a rock layer or any other such conditions are encountered.

D. Protect all existing utilities and features to remain on and adjacent to the project site during construction. Repair, at its own cost, all damage resulting from his operations or negligence.

E. The Irrigation Contractor shall coordinate with the General Contractor for installation of required sleeving as shown on the plans prior to paving operations.

F. Verify and be familiar with the existing irrigation systems in areas adjacent to and within the Project area of work.

G. Protect all existing irrigation systems, in areas adjacent to and within the project area of work, from damage due to his operations.

H. Notify Owner’s Representative if any existing system is temporarily shut off, capped or modified. Provide 48-hour notice, prior to turning off or modifying any existing irrigation system.

I. Repair or replace all existing irrigation systems, in areas adjacent to and within the project area of work, damaged by the construction of this project. Adjacent irrigation systems shall be made completely operational and provide complete coverage of the existing landscaped areas. All repairs shall be complete to the satisfaction of the Owner’s Representative.

J. Provide bore holes under any existing pavement or paving encountered for the required lateral, mainline and low voltage control wire sleeving. Bore holes under 2 inches in diameter and smaller shall be made with a BulletMole® underground boring tool as manufactured by Dimension Tools, LLC (Contact telephone number (888)-650-5554 or at www.bulletmole.com). Bore holes larger than 2 inches in diameter shall be made with an approved mechanical boring tool. No air jacking or hydraulic boring of any kind shall be allowed.

1.7 STORAGE AND HANDLING

A. Use all means necessary to protect irrigation system materials before, during, and after installation and to protect the installation work and materials of all other trades. In the event of damage, immediately make all repairs and replacements necessary to the acceptance of the Landscape Architect and Owner and at no additional cost to the Owner.

B. Exercise care in handling, loading, unloading, and storing plastic pipe and fittings under cover until ready to install. Transport plastic pipe only on a vehicle with a bed long enough to allow the pipe to lay flat to avoid undue bending and concentrated external load.

1.8 CLEANUP AND DISPOSAL

A. Dispose of waste, trash, and debris in accordance with applicable laws and ordinances and as prescribed by authorities having jurisdiction. Bury no such waste material and debris on the site. Burning of trash and debris will not be permitted. Remove and dispose of rubbish and debris at frequent intervals or when ordered to do so by the Owner's authorized representative.

B. At the time of completion the entire site will be cleared of tools, equipment, rubbish and debris which shall be disposed of off-site in a legal disposal area.

1.9 TURNOVER ITEMS

A. Record Drawings:
   1. Record accurately on one set of drawings all changes in the work constituting departures from the original contract drawings and the actual final installed locations of all required components as shown below.
   2. The record drawings shall be prepared to the satisfaction of the Owner. Prior to final inspection of work, submit record drawings to the Landscape Architect or Owner's authorized representative.
   3. All record drawings shall be prepared using AutoCAD 2018 drafting software and the original irrigation drawings as a base. No manual drafted record drawings shall be acceptable. The Contractor may obtain digital base files from the Landscape Architect or Owner's authorized representative.
   4. If the Contractor is unable to provide the AutoCAD drafting necessary for the record drawings the irrigation designer does provide record drawing drafting as a separate service.
   5. Prior to final inspection of work, submit record drawings plotted onto vellum sheets for review by the Landscape Architect or Owner's authorized representative. After acceptance by the Landscape Architect, City Inspector or

Owner's authorized representative re-plot the record drawings onto reproducible Mylar sheets. The Contractor shall also provide record drawing information on a digital AutoCAD Release 2018 drawing file. All digital files shall be provided on a compact disc (CD) clearly marked with the project name, file descriptions and date.

a. Record drawing information and dimensions shall be collected on a day-to-day basis during the installation of the pressure mainline to fully indicate all routing locations and pipe depths. Locations for all other irrigation equipment shall be collected prior to the final inspection of the work.
b. Two dimensions from two permanent points of reference such as buildings, sidewalks, curbs, streetlights, hydrants, etc. shall be shown for each piece of irrigation equipment shown below. Where multiple components are installed with no reasonable reference point between the components, dimensioning may be made to the irrigation equipment. All irrigation symbols shall be clearly shown matching the irrigation legend for the drawings. All lettering on the record drawings shall be minimum 1/8 inch in size.

6. Show locations and depths of the following items:
   a. Point of connection (including water POC, backflow devices, master control valves, flow sensors, etc.)
   b. Routing of sprinkler pressure main lines (dimensions shown at a maximum of 100 feet along routing)
   c. Isolation valves
   d. Automatic remote control valves (indicate station number and size)
   e. Quick coupling valves
   f. Drip air relief and flush valves
   g. Routing of control wires where separate from irrigation mainline
   h. Irrigation controllers (indicate controller number and station count)
   i. Related equipment (as may be directed)

B. Controller Charts:
   1. Provide one controller chart for each automatic controller. Chart shall show the area covered by the particular controller. The areas covered by the individual control valves shall be indicated using colored highlighter pens. A minimum of six individual colors shall be used for the controller chart unless less than six control valves are indicated.
   2. Landscape Architect or Owner's authorized representative must approve record drawings before controller charts are prepared.
   3. The chart is to be a reduced copy of the actual "record" drawing. In the event the controller sequence is not legible when the drawing is reduced, it shall be enlarged to a readable size.
   4. When completed and approved, the chart shall be hermetically sealed between two pieces of plastic, each piece being a minimum 20 mils in thickness.

C. Operation and Maintenance Manuals:
   1. Two individually bound copies of operation and maintenance manuals shall be delivered to the Landscape Architect or Owner's authorized representative at least 10 calendar days prior to final inspection. The manuals shall describe the material installed and the proper operation of the system.
   2. Each complete, bound manual shall include the following information:

3. Index sheet stating Contractor's address and telephone number, duration of guarantee period, list of equipment including names and addresses of local manufacturer representatives.
    a. Operating and maintenance instructions for all equipment.
    b. Spare parts lists and related manufacturer information for all equipment.

D. Equipment:
1. Supply as a part of this contract the following items:
    a. Two (2) wrenches for disassembly and adjustment of each type of sprinkler head used in the irrigation system.
    b. Three 30-inch sprinkler keys for manual operation of control valves.
    c. Two keys for each automatic controller.
    d. Two quick coupler keys with a 1" bronze hose bib, bent nose type with hand wheel and two coupler lid keys.
    e. One valve box cover key or wrench.
    f. Six extra sprinkler heads of each size and type.
    g. For specified ball valves if required: One (1) 5-foot long valve handle, to fit the specified ball valves.
2. The above equipment shall be turned over to Owner's authorized representative at the final inspection.

1.10 COMPLETION

A. At the time of the pre-maintenance period inspection, the Landscape Architect, Owner's authorized representative, and governing agencies will inspect the work, and if not accepted, will prepare a list of items to be completed by the Contractor. Punch list to be checked off by contractor and submitted to Landscape Architect or Owner's authorized representative prior to any follow-up meeting. This checked off list to indicate that all punch list items have been completed. At the time of the post-maintenance period or final inspection the work will be re-inspected and final acceptance will be in writing by the Landscape Architect, Owner's authorized representative, and governing agencies.

B. The Owner's authorized representative shall have final authority on all portions of the work.

C. After the system has been completed, the Contractor shall instruct Owner's authorized representative in the operation and maintenance of the irrigation system and shall furnish a complete set of operating and maintenance instructions.

D. Any settling of trenches which may occur during the one-year period following acceptance shall be repaired to the Owner's satisfaction by the Contractor without any additional expense to the Owner. Repairs shall include the complete restoration of all damage to planting, paving or other improvements of any kind as a result of the work.

1.11 GUARANTEE

A. The entire sprinkler system, including all work done under this contract, shall be unconditionally guaranteed against all defects and fault of material and

workmanship, including settling of backfilled areas below grade, for a period of one (1) year following the filing of the Notice of Completion.

B. Should any problem with the irrigation system be discovered within the guarantee period, it shall be corrected by the Contractor at no additional expense to Owner within ten (10) calendar days of receipt of written notice from Owner. When the nature of the repairs as determined by the Owner constitute an emergency (i.e. broken pressure line) the Owner may proceed to make repairs at the Contractor's expense. Any and all damages to existing improvement resulting either from faulty materials or workmanship, or from the necessary repairs to correct same, shall be repaired to the satisfaction of the Owner by the Contractor, all at no additional cost to the Owner.

C. Guarantee shall be submitted on Contractor's own letterhead as follows:

GUARANTEE FOR SPRINKLER IRRIGATION SYSTEM

We hereby guarantee that the sprinkler irrigation system we have furnished and installed is free from defects in materials and workmanship, and the work has been completed in accordance with the drawings and specifications, ordinary wear and tear and unusual abuse, or neglect excepted. We agree to repair or replace any defective material during the period of one year from date of filing of the Notice of Completion and also to repair or replace any damage resulting from the repairing or replacing of such defects at no additional cost to the Owner. We shall make such repairs or replacements within 10 calendar days following written notification by the Owner. In the event of our failure to make such repairs or replacements within the time specified after receipt of written notice from Owner, we authorize the Owner to proceed to have said repairs or replacements made at our expense and we will pay the costs and charges therefore upon demand.

PROJECT NAME:
PROJECT LOCATION:

CONTRACTOR NAME:
ADDRESS:

TELEPHONE:

SIGNED:

DATE:

PART 2 - MATERIALS

2.1 SUMMARY

Use only new materials of the manufacturer, size and type shown on the drawings and specifications. Materials or equipment installed or furnished that do not meet Architect's will be rejected and shall be removed from the site at no additional expense.

2.2 PIPE

A. Pressure supply line between the water meter and the backflow prevention device shall be type K copper, one size larger than backflow device.

B. Backflow prevention assemblies, and all other above grade assemblies, shall be constructed of threaded brass pipe and threaded brass fittings the same size as the backflow device, unless otherwise directed.

C. Pressure supply lines 2 inches in diameter and up to 3 inches in diameter downstream of backflow prevention unit shall be Class 315 solvent weld PVC. Piping shall conform to ASTM D2241.

D. Non-pressure lines 3/4 inch in diameter and larger downstream of the remote control valve shall be SCH 40 solvent weld PVC conforming to ASTM D1785.

2.3 METAL PIPE FITTINGS

A. Brass pipe shall be 85 percent red brass, ANSI, IPS Standard 125 pounds, Schedule 40 screwed pipe.

B. Fittings shall be medium brass, screwed 125-pound class.

C. Copper pipe and fittings shall be Type "K" sweat soldered, or brazed as indicated on the drawings.

2.4 PLASTIC PIPE FITTINGS

A. Pipe shall be marked continuously with manufacturer's name, nominal pipe size, schedule or class, PVC type and grade, National Sanitation Foundation approval, Commercial Standards designation, and date of extrusion.

B. All plastic pipe shall be extruded of an improved PVC virgin pipe compound in accordance with ASTM D2672, ASTM D2241 or ASTM D1785.

C. All solvent weld PVC fittings shall be standard weight Schedule 40 (and Schedule 80 where specified on the irrigation detail sheet, all mainline fittings shall be Schedule 80 PVC) and shall be injection molded of an improved virgin PVC fitting compound. Slip PVC fittings shall be the "deep socket" bracketed type. Threaded plastic fittings shall be injection molded. All tees and ells shall be side gated. All fittings shall conform to ASTM D2464 and ASTM D2466.

D. All threaded nipples shall be standard weight Schedule 80 with molded threads and shall conform to ASTM D1785.

E. All solvent cementing of plastic pipe and fittings shall be a two-step process, using primer and solvent cement applied per the manufacturer's recommendations. Cement shall be of a fluid consistency, not gel-like or ropy. Solvent cementing shall be in conformance with ASTM D2564 and ASTM D2855.

F. When connection is plastic to metal, female adapters shall be hand tightened, plus one turn with a strap wrench. Joint compound shall be non-lead base Teflon paste, tape, or equal.

G. All pressure mainlines installed with solvent weld PVC fittings shall be installed with concrete thrust blocking at all directional changes in the mainline routing. Concrete thrust blocking shall not be required when ductile iron fittings and mechanical restraints are specified.

H. PVC fittings used with UVR pipe shall be Schedule 40 UVR PVC type.

2.5 BACKFLOW PREVENTION UNITS

A. The backflow prevention unit shall be of the manufacturer, size, and type indicated on the drawings.

B. The backflow prevention unit shall be installed in accordance with the requirements set forth by local codes.

C. The backflow enclosure shall be of the manufacturer, size, and type indicated on the drawings.

D. The backflow freeze prevention cover shall be of the manufacturer, size, and type indicated on the drawings.

2.6 VALVES

A. Master Control Valves:
1. Master control valves shall be of the manufacturer, size, and type indicated on the drawings.
2. Master control valves shall be electrically operated.
3. Master control valves shall be normally open type as indicated on the drawings.
4. Provide Christy's valve ID tag for master control valve with valve number
5. Provide a single station valve decoder of the manufacturer, size and type indicated on the drawings for the master control valve.

B. Flow Sensor:
1. Flow Sensor shall be of the manufacturer, size, and type indicated on the drawings.
2. Flow Sensor shall be PVC tee type with plastic impellor.
3. Provide a sensor decoder of the manufacturer, size, and type indicated on the drawings for each flow sensor.

C. Ball Valves:
1. Ball valves shall be of the manufacturer, size, and type indicated on the drawings.
2. Ball valves shall be PVC type, double union, with slow closing mechanism to prevent fast closing of the valve.
3. All ball valves shall have PVC socket, solvent weld connections.

D. Quick Coupler Valves:

1. Quick coupler valves shall be of the manufacturer, size, and type indicated on the drawings.
2. Quick coupler valves shall be brass with a wall thickness guaranteed to withstand normal working pressure of 150 psi without leakage. Valves shall have 1" female threads opening at base, with two-piece body. Valves to be operated only with a coupler key, designed for that purpose. Coupler key is inserted into valve and a positive, watertight connection shall be made between the coupler key and valve.

E. Remote Control Valves:
1. Automatic control valves shall be of the manufacturer, size, and type indicated on the drawings.
2. Automatic control valves shall be electrically operated.
3. Provide Christy's valve ID tags for each remote control valve with valve number.
4. Provide a single (or multiple) station valve decoder of the manufacturer, size and type indicated on the drawings for each remote control valve or remote control valve manifold.

2.7 VALVE BOXES

A. Valve boxes shall be fabricated from a durable, weather-resistant plastic material resistant to sunlight and chemical action of soils.

B. The valve box cover shall be black in color in shrub areas and secured with a hidden latch mechanism or bolts.

C. Valve box extensions shall be by the same manufacturer as the valve box.

D. The plastic irrigation valve box cover shall be an overlapping type.

E. Automatic control valve, master valve, and flow sensor boxes shall be 17"x11"x12" 'nominal' rectangular size. Valve boxes for drip valve assemblies shall be Jumbo valve boxes size as required to fit assemblies. Valve box covers shall be marked "RCV" with the valve identification number, or "MV", "FS" "heat branded" onto the cover in 1-1/4 inch high letters / numbers.

F. Quick coupler and ball valve boxes shall be 10" circular size. Valve box covers shall be marked with "QCV" or "BV" "heat branded" onto the cover in 1-1/4 inch high letters.

2.8 IRRIGATION HEADS AND INLINE DRIP TUBING

A. Irrigation heads and inline drip tubing shall be of the manufacturer, size, type, with radius of throw, operating pressure, and discharge rate indicated on the drawings.

B. Irrigation heads and inline drip tubing shall be used as indicated on the drawings.

2.9 DRIP IRRIGATION EQUIPMENT

Drip tubing equipment such as flush valves, wye strainers and pressure regulators shall be of the manufacturer, size, and type indicated on the drawings.

2.10 AUTOMATIC CONTROLLER

A. Automatic controller shall be of the manufacturer, size, and type indicated on the drawings.

B. Controller enclosure shall be of the manufacturer, size, and type indicated on the drawings.

C. Controller shall be grounded according to local codes using equipment of the manufacturer, size, and type indicated on the drawings; or as required by local codes and ordinances.

2.11 ELECTRICAL

A. All electrical equipment shall be NEMA Type 3, waterproofed for exterior installations.

B. All electrical work shall conform to local codes and ordinances.

2.12 LOW VOLTAGE CONTROL WIRING

A. Remote control wire shall be direct-burial AWG-UF type, size as indicated on the drawings, and in no case smaller than 14 gauge.

B. Remote control wire shall be 14 AWG solid core twisted pair, type as indicated on the irrigation drawings.

C. Waterproof connections shall of the manufacturer, size, and type indicated on the drawings.

D. Common wires shall be white in color. Control wires shall be red (where two or more controllers are used, the control wires shall be a different color for each controller. These colors shall be noted on the "Record Drawings" plans located on controller door).

E. Ground wires shall be green in color or bare copper and in no case smaller than 6 gauge.

2.13 MISCELLANEOUS EQUIPMENT

A. Landscape Fabric:
   1. Landscape fabric for valve box assemblies shall be 5.0- oz. weight woven polypropylene weed barrier. Landscape fabric shall have a burst strength of 225 PSI, a puncture strength of 60 lbs. and capable of water flow of 12 gallons per minute per square foot.
   2. Type: DeWitt Pro 5 Weed Barrier or approved equal.

B. Equipment such as flow sensors, rain sensors, freeze sensors, flush valves, air relief valves, wye strainers, and master valves shall be of the manufacturer, size and type indicated on the drawings.

PART 3 - EXECUTION

3.1 SITE CONDITIONS

A. Inspections:
1. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.
2. Verify that irrigation system may be installed in strict accordance with all pertinent codes and regulations, the original design, the referenced standards, and the manufacturer's recommendations.

B. Discrepancies:
1. In the event of discrepancy, immediately notify the Landscape Architect or Owner's authorized representative.
2. Do not proceed with installation in areas of discrepancy until all discrepancies have been resolved.

C. Grades:
1. Before starting work, carefully check all grades to determine that work may safely proceed, keeping within the specified material depths with respect to finish grade.
2. Final grades shall be accepted by the Engineer before work on this section will be allowed to begin.

D. Field Measurements:
1. Make all necessary measurements in the field to ensure precise fit of items in accordance with the original design. Contractor shall coordinate the installation of all irrigation materials with all other work.
2. All scaled dimensions are approximate. The Contractor shall check and verify all size dimensions prior to proceeding with work under this section.
3. Exercise extreme care in excavating and working near existing utilities. Contractor shall be responsible for damages to utilities, which are caused by his operations or neglect.

E. Diagrammatic Intent:
The drawings are essentially diagrammatic. The size and location of equipment and fixtures are drawn to scale where possible. Provide offsets in piping and changes in equipment locations as necessary to conform with structures and to avoid obstructions or conflicts with other work at no additional expense to Owner.

F. Layout:
1. Prior to installation, the Contractor shall stake out all pressure supply lines, routing and location of sprinkler heads, valves, backflow preventer, and automatic controller.
2. Layout irrigation system and make minor adjustments required due to differences between site and drawings. Where piping is shown on drawings under paved areas, but running parallel and adjacent to planted areas, install the piping in the planted areas.

G. Water Supply:

Connections to, or the installation of, the water supply shall be at the locations shown on the drawings. Minor changes caused by actual site conditions shall be made at no additional expense to Owner.

H. Electrical Service:
1. Connections to the electrical supply shall be at the locations shown on the drawings. Minor changes caused by actual site conditions shall be made at no additional expense to Owner.
2. Contractor shall make electrical connections to the irrigation controller. Electrical power source to controller locations shall be provided by others.
3. Contractor shall make electrical connections to the irrigation controller. 230-volt single-phase electrical power source to pump assembly location shall be provided by others per NEC codes.

3.2 TRENCHING

A. Excavations shall be straight with vertical sides, even grade, and support pipe continuously on bottom of trench. Trenching excavation shall follow layout indicated on drawings to the depths below finished grade and as noted. Where lines occur under paved area, these dimensions shall be considered below subgrade.

B. Provide minimum cover of 18 inches on pressure supply lines 2 ½ inches and smaller.

C. Provide minimum cover of 24 inches on pressure supply lines 3 inches and larger.

D. Provide minimum cover of 18 inches for control wires within planters.

E. Provide minimum cover of 24 inches for control wires within sleeves below paving.

F. Provide minimum cover of 36 inches on pressure supply lines under vehicular travel ways.

G. Provide minimum cover of 12 inches for non-pressure lines.

H. Pipes installed in a common trench shall have a 4-inch minimum space between pipes.

3.3 THRUST BLOCKS

A. Thrust blocks must be constructed of Class “B” concrete.

B. Thrust blocks shall be poured against undisturbed site soil.

C. PVC fitting joints shall be kept free of concrete. Do not encase fitting in concrete.

D. Thrust blocking shall be sized to provide the minimum bearing areas as shown below. Bearing areas indicated have been calculated for Class 200 PVC pipe at a test pressure of 150 PSI in soil with 2,000 PSI bearing capacity. Increase thrust block sizing as necessary for varying soil conditions.
1. Provide a minimum thrust block bearing area of 2.0 square feet on all bends (all degrees) and tees installed on pressure supply lines 4 inches and smaller.

2. Provide a minimum thrust block bearing area of 4.0 square feet on all 90 degree bends installed on pressure supply lines 6 inches in size. Bends of less than 90 degrees shall require a thrust block with a bearing area of 2.0 square feet for 6 inch mainline.
3. Provide a minimum thrust block bearing area of 3.0 square feet on all tees installed on pressure supply lines 6 inches in size.
4. Provide a minimum thrust block bearing area of 6.5 square feet on all 90 degree bends installed on pressure supply lines 8 inches in size. Bends of less than 90 degrees shall require a thrust block with a bearing area of 3.5 square feet for 8 inch mainline.
5. Provide a minimum thrust block bearing area of 4.5 square feet on all tees installed on pressure supply lines 8 inches in size.

3.4 BACKFILLING

A. Backfill material on all lines shall be the same as adjacent soil free of debris, litter, and rocks over 1/2 inches in diameter.

B. Backfill shall be tamped in 4-inch layers under the pipe and uniformly on both sides for the full width of the trench and the full length of the pipe. Backfill materials shall be sufficiently damp to permit thorough compaction, free of voids. Backfill shall be compacted to dry density equal to adjacent undisturbed soil and shall conform to adjacent grades.

C. Flooding in lieu of tamping is not allowed.

D. Under no circumstances shall truck wheels be used to compact backfill.

E. Provide sand backfill a minimum of 4 inches over and under all piping under paved areas.

3.5 PIPING

A. Piping under existing pavement may be installed by jacking, boring, or hydraulic driving. No hydraulic driving is permitted under asphalt pavement.

B. Cutting or breaking of existing pavement is not permitted.

C. Carefully inspect all pipe and fittings before installation, removing dirt, scale, burrs, and reaming. Install pipe with all markings up for visual inspection and verification.

D. Remove all dented and damaged pipe sections.

E. All lines shall have a minimum clearance of 4 inches from each other and 12 inches from lines of other trades.

F. Parallel lines shall not be installed directly over each other.

G. In solvent welding, use only the specified primer and solvent cement and make all joints in strict accordance with the manufacturer's recommended methods including

wiping all excess solvent from each weld. Allow solvent welds at least 15 minutes setup time before moving or handling and 24 hours curing time before filling.

H. PVC pipe shall be installed in a manner, which will provide for expansion and contraction as recommended by the pipe manufacturer.

I. Center load all plastic pipe prior to pressure testing.

J. All threaded plastic-to-plastic connections shall be assembled using Teflon tape or Teflon paste.

K. For plastic-to-metal connections, work the metal connections first. Use a non-hardening pipe dope an all threaded plastic-to-metal connections, except where noted otherwise. All plastic-to-metal connections shall be made with plastic male adapters.

3.6 CONTROLLER

A. The exact location of the controller shall be approved by the Landscape Architect or Owner's authorized representative before installation. The electrical service shall be coordinated with this location.

B. The Irrigation Contractor shall be responsible for the final electrical hook up to the irrigation controller.

C. The irrigation system shall be programmed to operate during the periods of minimal use of the design area.

3.7 CONTROL WIRING

A. Low voltage control wiring shall occupy the same trench and shall be installed along the same route as the pressure supply lines whenever possible.

B. Where more than one wire is placed in a trench, the wiring shall be taped together in a bundle at intervals of 10 feet. Bundle shall be secured to the mainline with tape at intervals of 20 feet.

C. All connections shall be of an approved type and shall occur in a valve box. Provide an 18-inch service loop at each connection.

D. An expansion loop of 12 inches shall be provided at each wire connection and/or directional change, and one of 24 inches shall be provided at each remote control valve.

E. A continuous run of wire shall be used between a controller and each remote control valve. Under no circumstances shall splices be used without prior approval.

3.8 VALVES

A. Automatic control valves, quick coupler, and ball valves are to be installed in the approximate locations indicated on the drawings.

B. Valve shall be installed in shrub areas whenever possible.

C. Install all valves as indicated in the detail drawings.

D. Valves to be installed in valve boxes shall be installed one valve per box.

E. Provide valve ID tags for each remote control valve with valve number.

3.9 VALVE BOXES

A. Valve boxes shall be installed in shrub areas whenever possible.

B. Each valve box shall be installed on a foundation of 3/4 inch gravel backfill, 3 cubic feet minimum. Valve boxes shall be installed with their tops 1/2 inch above the surface of surrounding finish grade in lawn areas and 2 inches above finish grade in ground cover areas.

3.10 IRRIGATION HEADS AND INLINE DRIP TUBING

A. Irrigation heads and inline drip tubing shall be installed as indicated on the drawings.

B. Spacing of heads and inline drip tubing shall not exceed maximum indicated on the drawings.

C. Riser nipples shall be of the same size as the riser opening in the sprinkler body.

3.11 BACKFLOW PREVENTION UNITS

A. Backflow Prevention Units shall be installed as indicated on the drawings. The backflow prevention unit shall be installed in accordance with the requirements set forth by local codes.

B. The exact location of the backflow device shall be approved by the Landscape Architect or owner's authorized representative before installation.

C. The contractor shall be responsible for the testing and certification of the backflow device for proper operation. Testing and certification shall be performed by a state qualified backflow tester.

3.12 MISCELLANEOUS EQUIPMENT

A. Install all assemblies specified herein according to the respective detail drawings or specifications, using best standard practices.

B. Quick coupler valves shall be set approximately 18 inches from walks, curbs, header boards, or paved areas where applicable.

C. Install devices such as rain sensors, freeze sensors, flush valves, and air relief valves, master valves and flow sensors as indicated on the drawings and as recommended by the manufacturer.

3.13 FLUSHING THE SYSTEM

A. Prior to installation of irrigation heads, the valves shall be opened and a full head of water used to flush out the lines and risers.

B. Irrigation heads shall be installed after flushing the system has been completed.

3.14 ADJUSTING THE SYSTEM

A. Contractor shall adjust valves, align heads, and check the coverage of each system prior to coverage test.

B. If it is determined by the Landscape Architect or Owner's authorized representative that additional adjustments or nozzle changes will be required to provide proper coverage, all necessary changes or adjustments shall be made prior to any planting.

C. The entire system shall be operating properly before any planting operations commence.

D. Automatic control valves are to be adjusted so that the irrigation heads, drip emitters and inline drip tubing operate at the pressure recommended by the manufacturer.

3.15 TESTING AND OBSERVATION

A. Do not allow or cause any of the work of this section to be covered up or enclosed until it has been observed, tested and accepted by the Landscape Architect, Owner, and governing agencies.

B. The Contractor shall be solely responsible for notifying the Landscape Architect, Owner, and governing agencies, a minimum of 48 hours in advance, where and when the work is ready for testing.

C. When the sprinkler system is completed, the Contractor shall perform a coverage test of each system in its entirety to determine if the water coverage for the planted areas is complete and adequate in the presence of the Landscape Architect.

D. The Contractor shall furnish all materials and perform all work required to correct any inadequacies of coverage due to deviations from the plans, or where the system has been willfully installed as indicated on the drawings when it is obviously inadequate, without bringing this to the attention of the Landscape Architect. This test shall be accepted by the Landscape Architect and accomplished before starting any planting.

E. Areas to be maintained for the formal maintenance period shall start maintenance at the same time, as directed by the Landscape Architect, Owner, and governing agencies. Partial areas will not be released into maintenance prior to completion of items listed in the pre-maintenance review. The maintenance period may not be phased.

F. If, after the maintenance review, the irrigation systems are not accepted by the Landscape Architect, the contractor shall reimburse the Architect for additional site

visits, or additional time required to review work. All additional time will be billed at the Architect's hourly rate and will be paid for by the contractor at no additional cost to the owner.

G. Final inspection will not commence without record drawings as prepared by the Irrigation Contractor.

3.16 MAINTENANCE

During the maintenance period the Contractor shall adjust and maintain the irrigation system in a fully operational condition providing complete irrigation coverage to all intended plantings.

3.17 COMPLETION CLEANING

Clean up shall be made as each portion of the work progresses. Refuse and excess dirt shall be removed from the site, all walks and paving shall be swept, and any damage sustained on the work of others shall be repaired to original conditions.

END OF SECTION

SECTION 329113 – PLANTING SOILS & PREPARATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Subgrade preparation.
   2. Planting soils.
   3. Soil amending.
   4. Preparation of planting areas.
   5. Finish grading for drainage.
   6. Root protection barrier

B. Related Sections:
   1. Section 015639 "Tree and Plant Protection" for Work within CRZs of existing trees to remain.
   2. Section 311000 "Site Clearing" for removal and disposal existing landscape elements indicated to be cleared.
   3. Section 329300 "Landscape Planting" for landscape edging.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data for the following, including sources:
   1. Planting Soil with components listed by percentage of volume.
   2. Compost and Seal of Testing Assurance (STA) certificate before application
   3. Organic Fertilizer.
   4. Mycorrhizal Fungi.
   5. Amendments: For any amendments required.
   6. Root barrier.
   7. Quantity Documentation: If requested, submit proof of quantities of compost or amendments applied so that application rates can be verified.

B. Product Certificates. Submit for each product, from manufacturer, within 90 days of delivery to site:
   1. Compost Certification: Provide copy of the producer's STA as issued by the U.S. Composting Council.
   2. Compost feedstock sources. Submit list of sources of feedstock and percentages in the final product.

C. Material Test Reports:
   1. Compost Technical Data Sheet including test results.
   2. Complete Soil Analysis for all soil types, including mineral components analysis, at least 45 days prior to installation:
      a. Planting Soil
      b. Include lab interpretation report for each.

D. Samples: 2-quarts per sample.
   1. Planting Soil Samples: Submit sample of planting soil, and structural soil, with analyses.
   2. Compost: Submit with laboratory analysis and certification.

E. Qualification Data: For qualified landscape Installer. Include list of similar projects completed by Installer demonstrating capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.

F. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before start of required maintenance periods.

G. Warranty: Submit special warranty.

H. Contract Closeout Submittals:
   1. Warranty: Sample of special warranty.

1.3 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Finish Grade: Elevation of finished surface of planting soil.

C. Planting Soil: A base soil that has been amended to produce a planting soil mixture best for plant growth.

D. 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.

E. Subsoil: All soil beneath the topsoil layer of the soil profile and typified by the lack of organic matter and soil organisms.

1.4 QUALITY ASSURANCE

A. Qualifications:
   1. Installer: A qualified landscape Installer whose work has resulted in successful establishment of plants.
      a. Experience: Five years' experience in landscape installation in addition to requirements in Section 014000 -- Quality Requirements.
      b. Installer's Field Supervision: Maintain an experienced full-time supervisor on Project site when work is in progress.
   2. Soil-Testing Laboratory Qualifications: An independent or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.
      a. Testing methods and written recommendations shall comply with USDA's Handbook No. 60.

B. Testing Laboratory Services:
   1. Provide to Lab:
      Provide the following information to soil testing laboratory for all samples tested:
      a. Project location.
      b. Description of type of plants to be used.
      c. Material Samples:
         1) From the source, take a minimum of ten representative 1-cup samples from equally spaced locations at 12-inch depth for each ingredient.
         2) Thoroughly mix all samples in a separate clean bucket for each soil type.

3) Place 2 cups of the mix into a sealable plastic bag for testing. Verify quantity of sample required by soil testing laboratory.
4) Label bag with site information, area of sample, contractor name and phone number.
5) Verify with selected laboratory that additional requirements do not apply.

2. Analyses Required: Conduct the following analyses within 90 days of delivery to the site.
   a. Compost:
      1) Timing: Prior to mixing into soils, dated no more than 90-days prior to installation.
      2) Analysis: Test for items listed in Part 2.
   b. Planting Soil, and Structural Soil:
      1) Test each soil type prior to amending:
         a) Timing: Prior to mixing.
         b) Analysis: Organic Matter content and sieve analysis for each mineral component of the mix--state gradation of sand, silt, and clay content per USDA Soil Classification system, including percent passing the #200 screen size.
      2) Soil analyses for the mixes:
         a) Timing: After mixing.
         b) Analyses:
            i) For Planting Soil: Organic Matter content and sieve analysis for mineral component of the mix--state gradation of sand, silt, and clay content per USDA Soil Classification system, including percent passing the #200 screen size.
            ii) For all mixes: Complete mineral and nutrient analysis.
         c) Report: Interpretation of nutrient analysis and written report from soil testing lab, including:
            i) Suitability of tested soil for growing intended plants.
            ii) Recommendations for soil amendments to be incorporated to produce soil conducive to healthy growth of intended plants.
            iii) Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.

C. Preinstallation Conference: Conduct conference at Project site, with Landscape Architect and Landscape Installer present. Discuss the following items:
   1. Laboratory Analyses.
   2. Products.
   3. Subgrade Preparation.
   4. Soil placement.
   5. Installation.
   6. Schedule and Staging.

D. Notification for Review: Notify Landscape Architect 5-days in advance of the following review points:
   1. Subgrade Preparation Review.
   2. Planting Soil Placement Review.
   3. Soil Preparation and Finish Grading Review.

1.5 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 conformance with state and federal laws if applicable.

B. Coordination: Blend, ship, deliver and install soils so that the following conditions are met:
   1. Components of stockpiled mixes do not segregate or become contaminated
   2. Coordinate placement and compaction of the soils to avoid damage to other installed work, such as waterproofing systems, subdrainage, or irrigation systems.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual grade elevations, service and utility locations and dimensions of planting areas and adjacent construction by field measurements before proceeding with planting work. Notify Landscape Architect if discrepancies exist between plans and actual conditions.

B. Weather Restrictions: Do not perform work of this section when soils or subgrades are excessively wet, in the opinion of the Landscape Architect.

1.7 WARRANTY

A. Warranty: Installer agrees to repair or replace work of this Section that fails in materials or workmanship, within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Excessive settling of soils.
      b. Presence of horsetail, morning glory, reed canary grass or other nuisance plants or noxious weeds in planting soils.
   2. Warranty Period from Date of Planting Completion: 12 months.
   3. Include the following remedial actions as a minimum at end of warranty period:
      a. Correct grades that have settled
      b. Provide nuisance and noxious weed eradication from planting areas. Do not use inorganic herbicide unless approved. Remove soils containing horsetail and replace.

1.8 MAINTENANCE

A. Maintenance: Maintain as required to eradicate imported weeds and correct settlement. Begin maintenance immediately after plants are installed and continue for 30 days after Planting Completion.

PART 2 - PRODUCTS

2.1 PLANTING SOIL (TOPSOIL):
   1. Planting soil is defined as on-site surface soil. Satisfactory planting soil shall be free of subsoil, clay, lumps, stones, and other objects over 4" in diameter, and without weeds, roots, and other objectionable material.
   2. Strip planting soil to whatever depths encountered, a maximum of (12) inches in a manner to prevent intermingling with the underlying subsoil or other objectionable material. Topsoil stripping is limited to area outside “Drip Line” of existing trees to remain and areas indicated on drawings and as approved by the Landscape Architect.
   3. Remove heavy growths of grass from areas before stripping.

4. Stockpile topsoil in storage piles in areas shown, or where designated by Landscape Architect. Construct storage piles to freely drain surface water. Cover storage piles if required to prevent windblown dust.
5. If sufficient on-site surface soil is not available, provide imported planting soil as specified below. Placement of dissimilar soils shall be coordinated with irrigation system valving to maintain separate valves for dissimilar soils.

2.2 IMPORTED PLANTING SOIL (TOPSOIL):

1. Imported planting soil shall be fertile, friable, natural, productive soil containing a normal amount of humus, and shall be capable of sustaining healthy plant life. Planting soil shall be free of subsoil, heavy or stiff clay, rocks, gravel, brush, roots, weeds, noxious seeds, sticks, trash, and other deleterious substances. Soil shall not be infested with nematodes or with other noxious animal life or toxic substances. Soil shall be obtained from well-drained, arable land, and shall be of an even texture. Soil shall not be taken from areas on which are growing any noxious weeds such as Morning Glory, Sorrel, or Bermuda Grass.
2. Imported planting soil shall have a pH value of between 6.0 and 7.5, a boron concentration of the saturation extract of less than 1 ppm, salinity of the saturation extract at 25 degrees C. of less than 4.0 millimoles, and a sodium absorption rate (SAR) of less than 8.
3. The silt and clay content of imported planting soil shall not exceed that of the existing soil it is to be placed over. It shall be a "Sandy Loam" as classified in accordance with USDA Standards with a combined total of between 25%to 40% Clay and Silt.
4. Make the site of the source of supply of planting soil available to the University's Representative for observation and approval prior to any hauling or placing of soil. In addition, submit for approval a 1-quart sample of soil, together with a standard soil analysis report by an accredited soils analyst showing chemical analysis stating source, fertility, agricultural suitability and particle size distribution of the soil. Deliver the sample to the University's Representative two weeks before starting the contemplated hauling of the soil. Following approval of the sample, provide a one-half cubic yard sample, which shall be stored at the site of work for comparison with subsequent loads of soil. The comparison sample shall be protected by a cover until the furnishing of all soil has been completed and accepted. Should the soil submittal lack certain requirements which can be added to the soil, the University's Representative will consider a request by the Contractor to amend the soil as recommended by the Soils Analyst at the Contractor's expense.

2.3 PLANTING SAND:

1. 100% medium/coarse, washed, sharp, angular, silt-free sand with the following sieve analysis:
    1. USDA Particle Size USDA Standard

Name	mm	Sieve #	% Retained	% Passing
Gravel	4.76	4	0%	100%
Fine Gravel	2.00	10	0-5%	95-100%
Very Coarse Sand	1.00	18	0-10%	90-100%
Coarse Sand	500 micron	35	0-35%	65-100%
Medium Sand	250 micron	60	50-100%	0-50%
Fine Sand	105 micron	140	0-30%	0-20%
Very Fine Sand	53 micron	270	0-15%	0-5%
Silt and Clay		Pan	0-5%	

2. Reaction (pH) of the saturated sand shall be between 6.0-8.0 as determined on the saturation extract solution:

a. Permissible range of Salinity, Boron and Sodium as follows:
   1) Salinity (Ece) 0-3.0 dS/m
   2) Boron 0.1.0 ppm
   3) Sodium 0-20 meq/L

2.4 COMPOST

A. Compost: Result of the biological degradation and transformation of Type I or III organic feedstocks under controlled conditions designed to promote aerobic decomposition and manufactured by a participant in the United States Composting Council's (USCC) STA program.
   1. Stable with regard to oxygen consumption and carbon dioxide generation.
   2. Mature with regard to its suitability for soil amendment or erosion control BMP.
   3. Moisture content resulting in no visible free water or dust produced in handling.

B. Production and quality in conformance with California state standards (CalEPA). Meets the following criteria:

Criteria	Testing Method
pH range of 5.5 to 8.0	TMECC 04.11-A "1:5 Slurry pH"
Moisture content 30-60%percent by weight	
100% passing through 1-inch sieve 90-100% passing through 5/8-inch sieve 40-90% passing through ¼-inch sieve	TMECC 02.02-B "Sample Sieving for Aggregate Size Classification"
Carbon:Nitrogen Ratio: Maximum 25:1	TMECC 04.01 "Total Carbon TMECC 04.02-D " Total Kjeldhal Nitrogen"
Total organic matter content of 45% to 75% dry weight basis	TMECC 05.07-A "Loss-On-Ignition Organic Matter Method"
Maturity >80%	TMECC 05.05-A "Germination and Vigor"
Soluble salt content of maximum 6 mmhos/cm	TMECC 04.10-A "1:% Slurry Method, Mass Basis"
Manufactured inert contaminants less than 1.0 percent dry weight or volume basis	TMECC 03.08-A "percent dry weight basis"
Minimum 65% by volume "Type 1 Feedstock" (recycled plant waste) A maximum of 35% by volume of other approved organic waste, "Type III Feedstock," may be substituted for Type I. This includes post-consumer food waste, but not biosolids.	

Stability: 7 or below	TMECC 05.08-B "Carbon Dioxide Evolution Rate"

C. Free of substances toxic to plantings.

D. Tested within 90 days prior to application.

2.5 MYCORRHIZAL FUNGI INOCULUM

A. Endo Mycorrhizal Fungi:
   1. Dry, granular endo mycorrhizal inoculum containing:
      a. 4 species of endomycorrhizae, 60,000 propagules per lb.
      b. Approved product: *MycoApply Granular Endo*, by Mycorrhizal Applications, Inc.
      c. Available from: Rocky Mountain Bio Products, http://www.rockymtnbioproducts.com/contact_us.htm

2.6 AMENDMENTS AND HERBICIDES

A. Herbicides: Registered and approved by 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 inorganic products unless approved by Landscape Architect. Restricted pesticides and herbicides must also be authorized in writing by authorities having jurisdiction.
   1. Use only organic herbicides.
   2. No pre-emergent herbicide allowed unless organic.

B. Soil Amendments: Use Organic soil amendments.
   Ground Redwood or Ground Fir Bark with the following properties:

Percent Passing	Sieve Designation		
100	9.51 mm	3/8"	
50-60	6.35 mm	1/4"	
20-40	4.76 mm	No. 4	
0-20	2.38 mm	No. 8	8 mesh

Redwood Sawdust
1. Dry bulk density, lbs. per cu. yd., 260-280
2. Nitrogen stabilized - dry weight basis, min. 0.4%
3. Salinity (ECe): 4.0 maximum
4. Organic Content: 90% minimum
5. Reaction (pH): 4.0 minimum

Ground Fir and/or Pine Bark
1. Dry bulk density, lbs. per cu. yd., Min. 350
2. Nitrogen stabilized - dry weight basis, min. 0.5%
3. Salinity (ECe): 4.0 maximum
4. Organic Content: 90% minimum
5. Reaction (pH): 4.0 minimum

2.7 DRAINAGE

A. Planter Drain Rock: Drain rock shall conform with the requirements for Gravel Backfill for Drains (Type 26 Aggregate) as specified in CALTRANS Standard Specifications.

B. Filter Fabric: Non-woven, needle-punched+-, geotextile filter sheet manufactured for separation applications and made of non-rotting polypropylene fibers to prevent particles from washing through the system.

2.8 ROOT BARRIER

A. Basis-of-Design Product: *CR-PE Series Dual Purpose Root and Water Barrier*, by Century Products, Anaheim, California.
   1. Color: Black.
   2. Material: Molded polyethylene rolls with minimum 50% recycled content and UV inhibitors.
   3. Thickness: 0.060-inch thick.
   4. Depth: 18-inches.
   5. Linear Application.
   6. Vertically integrated and flared root deflecting ribs protruding ½-inch from wall and placed 6- to 8-inches apart, and with a root-impervious molded self-correcting end.
   7. Self-interlocking connections.
   8. Century sealant, or approved.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive planting soil for compliance with requirements and conditions affecting installation and performance.
   1. Verify that subgrades are at proper elevation and will accommodate all required materials to required depths. Do not proceed with soil preparation until deficiencies are corrected.
   2. 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 areas.
      a. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination and replace with new planting soil.

B. Conduct Soil Analyses, as described in Part 1.

C. Apply additional amendments in the quantities recommended by soil testing lab for each planting type, and thoroughly blend into base soils off-site to create planting soil.

D. Remove from planting soil all roots, plants, weeds, sod, stones larger than 1-inch in any dimension, clods, pockets of coarse sand, construction debris and other extraneous materials harmful to plant growth.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PROTECTION

A. Soil Protection:
   1. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
   2. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.

3. Erosion control: 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.
   a. Uniformly moisten excessively dry soil that is not workable and which is too dusty.
4. Protect planting from compaction after subgrades have been loosened and soils have been installed, amended and prepared

B. Existing Trees to Remain:
1. Do not rototill soils within Critical Root Zones (CRZs) of existing trees to remain. See Section 015639 "Tree and Plant Protection" for Work within CRZs of existing trees to remain.

3.3 SUBGRADE PREPARATION

A. Remove all construction debris and extraneous matter from planting areas.

B. Eradicate unwanted vegetation.

C. On-Grade Areas:
1. Loosen subgrade of planting areas to a minimum depth 8 inches. Remove stones larger than 1-1/2 inches in any dimension and sticks, roots, rubbish and other extraneous matter and legally dispose of them off Owner's property.

D. Notify Landscape Architect for Subgrade Preparation Review.

3.4 INSTALL ROOT BARRIER

A. Install per manufacturer's recommendations, using linear application.
B. Install continuous root barrier extending 8 feet in each direction from the tree trunk where trees are located within 8 feet of paving.

3.5 INSTALL SOILS

A. Placement Schedule:
1. On-Grade Areas:
   a. Sandy loam base layer—install to depth required below Standard Planting Soil to produce final planting soil depths:
      1) At areas adjacent to structural soil: Depths shown.
      2) At areas not adjacent to structural soil: 2-feet total depth.
   b. Place Standard Planting Soil to 12-inch depth over sandy loam base layer.

B. Spread to required depths, but not less than required to meet finish grades and profiles after amending, mulching and natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.
1. Spread initial lift of soil to a depth of 6-inches over prepared subgrade. At on-grade areas mix thoroughly into top 4 inches of subgrade.
2. Place remaining planting soil in two lifts, lightly compacting lifts. Allow for settling and place additional planting soil as needed. Place enough soil to meet finished grades within specified tolerances and allow for settlement.

C. Compact planting soils to 85% compaction.

D. Notify Landscape Architect for Planting Soil Placement Review.

E. Spread Endomycorrhizal Fungi at all planting and seeded areas at manufacturer's recommended rates immediately prior to planting.

3.6 REMOVE FROM PLANTING AREAS

A. All Planting Areas: Remove roots, plants, weeds, sod, stones larger than 1-inch in any dimension, clods, pockets of coarse sand, construction debris and other extraneous materials harmful to plant growth.

3.7 FINISH GRADING

A. Grade areas, lightly roll and rake, resulting in a smooth, uniform surface plane with loose, uniformly fine texture. Provide positive drainage at all planting areas, except at bioretention planters and where shown. Crown all planting areas at center or slope grades away from buildings unless otherwise shown. Ensure that grades are as shown after light rolling and natural settlement.

B. Planting Areas:
   1. Rake, remove ridges, and fill depressions to meet finish grades and profiles shown.
   2. Finish grade planted areas at contact points with paving or curb as shown.

C. Eradicate unwanted vegetation and restore planting areas if eroded or otherwise disturbed after finish grading.

D. Notify Landscape Architect for Soil Preparation and Finish Grading Review.

3.8 MAINTENANCE

A. 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.

3.9 CLEANUP AND PROTECTION

A. During soil preparation, keep adjacent paving and construction clean and work area in an orderly condition.

B. Protect planting soils from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damage or disturbance.

3.10 DISPOSAL

A. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

END OF SECTION

SECTION 329200 - TURF AND GRASSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Lawn from Sod as shown on landscape drawings.

B. Related Sections:

1. Section 329113 "Soil Preparation."
2. Section 329300 “Landscape Planting” for mulch, maintenance period and requirements.

1.2 DEFINITIONS

A. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

B. 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" and drawing designations for planting soils.

C. 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.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site with landscape architect, owners representative and landscape contractor.

1.4 INFORMATIONAL SUBMITTALS

A. Certification of grass seed and sod: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

1. Certification of each seed mixture for turfgrass sod. Include identification of source and name and telephone number of suppliers.

B. Product certificates.

C. Herbicides: Product label and manufacturer's application instructions specific to Project.

1.5 CLOSEOUT SUBMITTAL

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.

1.6 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. Accompany each delivery of bulk materials with appropriate certificates.

PART 2 - PRODUCTS

2.1 LAWN SOD (Buffalo Grass) or approved equal.

A. Supplier: Southland Sod Farms or approved equal

2599 E. Hueneme Rd. Oxnard, CA 93033; 800-532-3489; https://www.sod.com/

2.2 FERTILIZERS

A. Supplier: Hendrikus Organics, PO Box 1289, Issaquah, WA, 98027; 425-392-9977; info@hendrikusorganics.com

B. Seasons 8-0-4 Turf Fertilizer: Granular, slow-release fertilizer. 100% Organic.

2.3 MULCHES

A. Compost Mulch: Refer to Section 329300 "Landscape Planting."

2.4 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.

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 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.

3.3 WARRANTY AND REPLACEMENT

A. Verify with grass fill paver manufacturer True Grid, that sod has been installed in accordance with their guidelines for firetruck lanes.

B. Provide a uniform stand of grass. Re-sod areas as specified to provide a uniform stand of grass until all affected areas are accepted by the Engineer. All areas failing to vigorously establish within 90 days after germination or one growing season (whichever is longest), shall be redone at the Contractor's expense.

END OF SECTION

SECTION 329219 – PERMANENT HYDROSEED

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all permanent hydroseeding work as shown on the drawings and as specified. Work includes soil preparation, hydroseed application, erosion control netting, watering, and maintenance until vegetation is established.

B. Related work specified elsewhere includes:
1. Section 015639 "Tree Protection."
2. Section 311000 "Site Clearing."
3. Section 312000 "Earthwork."
4. Section 328400 "Landscape Irrigation."
5. Section 329113, "Planting Soils and Preparation."
6. Section 329300 "Landscape Planting."

1.2 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 include 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: Imported soil; or manufactured soil; or existing, on-site 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 (Performance Specification)" 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.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
1. Attendees must include Landscape Architect, Construction Manager, and Landscape Contractor.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For landscape Installer.

B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

C. Certification of each seed mixture for turfgrass sod. Include identification of source and name and telephone number of supplier.

D. Product Certificates: For fertilizers, from manufacturer.

E. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

F. Limited pesticide and herbicide may be applied pursuant to the King County Noxious Weed Control Board best management practices, specific to the species needing control, when that is determined to be the best method of control for the location. Federal, State, and local regulations of pesticides and water quality must be followed, including requirements for pesticide applicator licensing from the Washington State Department of Agriculture.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of turf and meadows during a calendar year. Submit before expiration of required maintenance periods.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf and meadow establishment.
   1. Professional Membership: Installer shall be a member in good standing of either the National Association of Landscape Professionals or AmericanHort.
   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 one of the following categories from the National Association of Landscape Professionals:
      a. Landscape Industry Certified Technician - Exterior.
      b. Landscape Industry Certified Lawn Care Manager.
      c. Landscape Industry Certified Lawn Care Technician.
   5. Pesticide Applicator: State licensed, commercial.

1.7 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. Bulk Materials:
1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Accompany each delivery of bulk materials with appropriate certificates.

1.8 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 PERMANENT HYDROSEED

A. Seed Species (SLO SB & Ventura Coast Lower Growing Native Ornamental Erosion Control Mix)
1. Quality, Non-State Certified: Seed mixes as listed below for solar exposure, with not less than 85 percent germination, not less than 95 percent pure seed, and not more than 0.5 percent weed seed.
a. Available from Pacific Coast Seed – Phone: 805.684.0436

B. SLO SB & Ventura Coast Lower Growing Native Ornamental Erosion Control Mix

Species	Common Name	Bulk Lbs/Acre
Acmispon glaber	Deerweed	4.00
Acmispon maritimus	Coastal Lotus	1.00
Clarkia bottae	Punchbowl Godetia	2.00
Collinsia heterophylla	Chinese Houses	0.50
Corethrogyne filaginifolia	Sandaster	0.50
Diplacus longiflorus	Monkeyflower	2.50
Eriophyllum confertiflorum	Golden Yarrow	2.00
Eschscholzia californica	California Poppy	2.00
Festuca microstachys	Pacific Fescue	6.00
Heliotropium curassavicum	Salt Heliotrope	1.00
Lupinus bicolor	Miniature Lupine	2.00
Lupinus nanus	Sky Lupine	4.00
Melica imperfecta	Coast Melica	2.00

Poa secunda	Sandberg Bluegrass	6.00
Scrophularia californica	California Beeplant	0.50
Sisyrinchium bellum	Blue Eye Grass	0.50
Stipa cernua	Nodding Needlegrass	3.00
Trifolium willdenovii	Tomcat Clover	3.00

2.2 MULCH

A. Wood fiber or paper fiber mulch, uniformly dyed to ensure even application.

B. Apply within hydroseed slurry to achieve ¼–½ inch thickness over soil surface.

C. For flat planting areas (tree and shrub beds), provide additional 3 inch layer of organic mulch after germination as required by MWELO and CalGreen for water conservation.

D. Do not apply thick organic mulch on 3:1 or steeper slopes before germination.

2.3 TACKIFIER/STABILIZER

A. The Tackifier/Stabilizer shall be an organic substance supplied in powder form and shall be psilium-based and packed in clearly marked bags stating the contents of each package. The California Department of Food and Agriculture shall certify the material as an Auxiliary Soil Chemical.

2.4 PHOTODEGRADABLE EROSION CONTROL BLANKET

A. Supplier: North American Green or approved equal
   1. Rollmax Rolled Erosion Control Blanket, EroNet SC150
   2. Composition: 70% agricultural straw, 30% coconut fiber
   3. Functional longevity: up to 24 months
   4. Usage: To be installed over hydroseed on all slopes 3:1 and steeper, regardless of season
   5. Installation:
      a. Install per manufacturer's recommendations immediately after hydroseeding.
      b. Ensure grading, soil amendments, soil preparation, and seeding are complete prior to blanket installation.
      c. Secure blanket with biodegradable pins/staples at manufacturer-recommended spacing.
   6. Purpose: Provides slope stabilization, protects seeds from erosion, and aids in moisture retention until vegetation is established.

2.5 FERTILIZERS

A. Hydroseed fertilizer to be used in the slurry, shall be of commercial quality, conform to the requirements of the California Food and Agriculture Code, shall have a

guaranteed analysis for nitrogen, phosphorus and potassium. Products specified as slow-release shall have been tested and demonstrate a nearly linear release curve.

B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
   1. Composition:
      a. Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

2.6 MULCHES

A. Organic mulch: refer to Section 329300 "Landscape Planting."

2.7 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. 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.

3.3 INSTALLATION

A. Hydroseeding: Mix specified seed, slow-release fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.
   1. Mix slurry with nonasphaltic tackifier.
   2. Spray-apply slurry uniformly to all areas to be seeded in a two-step process. Apply first slurry coat at a rate so that mulch component is deposited at not less than 500-lb/acre dry weight, and seed component is deposited at not less than the specified seed-sowing rate. Apply slurry cover coat of fiber mulch (hydromulching) at a rate of 1000 lb/acre.
   3. Protect seeded areas with slopes exceeding 1:3 with erosion-control fiber mesh installed according to manufacturer's written standards.
   4. Application: Irrigate areas for (3) consecutive days to thoroughly moisten the top 6" of soil prior to hydroseeding operation. Begin application when the tank is full and the slurry is thoroughly mixed. Direct the spray such that slurry will penetrate the soil surface and impregnate the slurrly components into the soil. Apply a complete and even mulch layer over the entire area using the green dye as indicator.
   5. Protection: Take precautions to prevent the slurry from being sprayed onto adjacent property, plant materials, equipment, paving, walls, and other appurtenances. Clean-up of overspray shall be considered a part of this work and performed a no additional cost to the City. Protect stored materials and supplies associated with the work. Stored materials damaged during the progress of the work shall be disposed of off-site and replaced at no additional cost to the City. Protect hydroseeded areas against foot traffic and other uses until growth is established. Use of warning signs, caution tape, twine and flagging around the areas, shall be the responsibility of the Contractor.
   6. Coverage: Acceptance will be given at the end of the maintenance period when coverage is uniform over the entire area, with minimal bare or non-germinated areas, and the areas not exceeding 2 feet in its greatest dimension.
   7. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
   8. Do not use wet seed or seed that is moldy or otherwise damaged.

3.4 HYDROSSEDING MAINTENANCE

A. Maintain and establish by watering, weeding, mowing, trimming, replanting, and performing other operations as required to establish a healthy, viable hydroseeded area. Roll, regrade, and replant bare or eroded areas and remulch. 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 meadow 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 meadow 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: Watering shall be provided through the permanent irrigation system to maintain consistent soil moisture for seed germination and establishment. Adjust irrigation scheduling as necessary to prevent puddling, erosion, or displacement of seed or mulch.

3.5 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.

3.6 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.

3.7 WARRANTY AND REPLACEMENT

A. Provide a uniform stand of grass. Re-sod areas as specified to provide a uniform stand of grass until all affected areas are accepted by the Engineer. All areas failing to vigorously establish within 90 days after germination or one growing season (whichever is longest), shall be redone at the Contractor's expense.

END OF SECTION

SECTION 323300 LANDSCAPE PLANTING

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all planting soil, planting work, mulch, decomposed granite surfacing, edging, root barriers, filter fabric, recessed modular tree grate system, plant supports, and planting maintenance as shown on the drawings and as specified. Work includes layout, staking, installation, and coordination with related site elements.

B. Related work specified elsewhere includes:
   1. Section 015639 “Tree Protection.”
   2. Section 311000 “Site Clearing.”
   3. Section 312000 “Earthwork.”
   4. Section 328400 “Landscape Irrigation”
   5. Section 329113 “Planting Soils and Preparation.”
   6. Section 061000 “Rough Carpentry”
   7. Section 061533 “Wood Decking”

1.2 QUALITY ASSURANCE

A. Reference Standards:
   1. "Sunset Western Garden Book," Lane Publishing Co., Menlo Park, California; current edition.
   2. "American Standards for Nursery Stock," American Association of Nurseryman, 230 Southern Building, Washington, D.C. 20005.
   3. US Composting Council Compost Analysis Program (CAP)
   4. Test Methods for the Evaluation of Composting and Compost (TMECC)

B. Plant Material Standards
   1. Quality and Size of Plants: Conform to the State of California Grading Code of Nursery Stock, No. 1 grade. Use only nursery-grown stock which is free from insect pests and diseases.
   2. Comply with federal and state laws requiring inspection for plant diseases and infestations. Submit inspection certificates required by law with each shipment of plants and deliver certificates to the Landscape Architect. Obtain clearance from the County Agricultural Commissioner as required by law, before planting plants delivered from outside the County in which planted.

C. Testing Agency: Soil and Plant Laboratory, Inc. 352 Matthew Street (P.O. Box 153), Santa Clara, CA 95052; Tel. (408) 727-0330; or Root Zone Associates, P.O. Box 18911, San Jose, CA 95118; Tel. (408) 264-7024. Components of the agricultural suitability test shall include all major nutrients, pH, salinity, boron, sodium, micronutrients, copper, zinc, manganese and iron, adsorption rate, organic content and texture. Report to include amendment recommendations.

1.3 SUBMITTALS

A. Product Data: Manufacturer's current catalog cuts and specifications of the following:
   1. Fertilizers
   2. Iron sulfate
   3. Herbicide

4. Mulch
5. Tree ties and stakes
6. Filter fabric
7. Root Barrier
8. Modular recessed tree grate system
9. Underground tree guying (Tree stabilization system)
10. Landscape metal edging at planting and DG areas (Aluminum)

B. Shop Drawings:
   1. Modular recessed tree grate system
      a. Shop drawings showing tree grate layout, dimensions, and installation details.

C. Samples: Submit following samples along with certificates of compliance/analytical data from approved laboratory for degree of compliance:
   1. Plants: Submit typical sample of each variety or entire quantity to site.
   2. Organic Mulch: Submit 1-pint sample.
   3. Rock Mulch: 1-pint sample.
   4. Landscape Metal Edging.

D. Plant Photographs: Prior to shipping plants, provide color photographs in digital format of each required species and size of plant material as it will be furnished to the 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. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery. Review and acceptance of any or all of the photographs does not signify that those plants are acceptable, and until the plants are inspected by the Landscape Architect on site will acceptance of the plants be determined.

E. Delivery Receipts: Submit delivery receipts for quantities of organic soil amendments delivered to the site.

F. Proof of plant availability.

1.4 WARRANTY AND REPLACEMENT

A. Pre-Emergence Weed Killer: Warrant the work against weed growth for a period of four (4) months after application.

B. Warrant all plants and planting to be in a healthy, thriving condition until the end of the maintenance period, and deciduous trees beyond that time until active growth is evident.
   1. Replace all dead plants and plants not in a vigorous condition immediately as approved by Landscape Architect at Contractor's expense. Install replacement plants before the final acceptance at the size specified.

C. Warrant all plant material for a period of one year after final acceptance of the maintenance period against plant materials with defects at the time of installation.

D. Warrant plant installation and maintenance by Contractor against defects for a period of one year.

PART 2 - PRODUCTS

2.1 PLANTS

A. Plant the variety, quantity and size indicated. The total quantity tabulated on the drawings are considered approximate and furnished for convenience only. Contractor shall perform his/her own plant quantity calculations and shall provide all plants shown on the Drawings.

B. Tag plants of the type or name indicated and in accordance with the standard practice recommended by the American Association of Nurserymen.

C. Install healthy, shapely and well rooted plants with no evidence of having been root-bound, restricted or deformed.

D. Take precautions to ensure that the plants will arrive at the site in proper condition for successful growth. Protect plants in transit from windburn and sunburn. Protect and maintain plants on site by proper storage and watering.

E. Substitutions will not be permitted, except as follows:
   1. If proof is submitted to the Landscape Architect that any plant specified is not obtainable, a proposal will be considered for use of nearest equivalent size or variety with an equitable adjustment of contract price.
   2. Substantiate and submit proof of plant availability in writing to the Landscape Architect within 10 days after the effective date of Notice to Proceed.

F. Tree Form: Trees shall have a symmetrical form as typical for the species/cultivar and growth form.
   1. Central Leader for Single Trunk Trees: Trees shall have a single, relatively straight central leader and tapered trunk, free of co dominant stems and vigorous, upright branches that compete with the central leader. Preferably, the central leader should not have been headed; however, in cases where the original leader has been removed, an upright branch at least ½ the diameter of the original leader just below the pruning point shall be present.
   2. Potential Main Branches: Branches shall be evenly distributed radially around and appropriately spaced vertically along the trunk, forming a generally symmetrical crown typical for the species.
   3. Headed temporary branches should be distributed around and along the trunk as noted above and shall be no greater than 3/8" diameter, and no greater than ½ diameter of the trunk at point of attachment.

G. Tree Trunk
   1. Trunk diameter and taper shall be sufficient so that the tree will remain vertical without the support of a nursery stake.
   2. Trunk shall be free of wounds (except properly-made pruning cuts), sunburned areas, conks (fungal fruiting-bodies), wood cracks, bleeding areas, signs of boring insects, galls, cankers and/or lesions.
   3. Tree trunk diameter at 6" above the soil surface shall be within the diameter range shown for each container size below, except where shown otherwise:

Container	Trunk Diameter in inches	Soil level from Container Top
5 gallon	0.5" to 0.75"	1.25 to 2"
15 gallon	0.75" to 0.5"	1.75 to 2.75"
24" Box	1.5" to 2.5"	2.25 to 3"
36" Box	2.5" – 3.5"	3" – 3.75"

4. Tree trunks shall be undamaged and uncut with all old abrasions and cuts completely callused over. Do not prune plants prior to delivery.

H. Tree Roots
1. Trunk root collar (root crown) and large roots shall be free of circling and/or kinked roots. Contractor may be required to remove soil near the root collar in order to verify that circling and/or kinked roots are not present.
2. The tree shall be well rooted in the container. When the trunk is lifted the trunk and root system shall move as one and the rootball shall remain intact.
3. The top-most roots or root collar shall be within 1" above or below the soil surface. The soil level in the container shall be within the limits shown in above table.
4. The rootball periphery shall be free of large circling and bottom-matted roots.
5. On grafted or budded trees, there shall be no suckers from the root stock.

I. Shrubs
1. Each shrub must stand upright without support.
2. All container shrubs shall be free of girdling roots, defined as those roots greater than 1/8" diameter circling the periphery of the rootball. The top of the rootball shall be free of "Knees" (roots) protruding above the soil, and the bottom shall be free of matted roots.

J. Measure trees and shrubs with branches in normal position. Height and spread dimensions indicated refer to the main body of the plant, and not from branch tip to tip.

2.2 FERTILIZERS

A. Commercial fertilizer, pelleted or granular form, conform to the requirements of Chapter 7, Article 2, of the Agricultural Code of the State of California for fertilizing materials as follows:

Type A: 6% Nitrogen, 20% Phosphorus Acid and 20% Potash, (6-20-20).

Type B: 21-gram planting tablets 20% Nitrogen, 10% Phosphoric Acid and 5% Potash (20-10-5) available from Agriform or 10gm BestPacks packets 20% Nitrogen, 10% Phosphoric Acid and 5% Potash (20-10-5) available from Best Fertilizer Co.

Type C: Complete fertilizer 21% Nitrogen, 7% Phosphoric Acid and 14% Potash (21-7-14).

If commercial fertilizer having this analysis is not obtainable, other similar commercial fertilizer may be used providing it meets the approval of the Landscape Architect.

B. Maintenance Fertilizer: Type C

C. Sod Fertilizer: Provided by grower.

D. Iron Sulfate: Dry form.

2.3 PLANT BACKFILL:

A. Except for acid loving plants (Azaleas, Rhododendrons, Ferns, Camellias, etc.), use a mixture of 2 parts soil from the hole, and 1-part amendment with iron added at the following rates:

1 gallon plants	-	iron, 1/4 cup
5 gallon plants	-	iron, 1/3 cup
15 gallon plants	-	iron, 1/2 cup
24" box and larger	-	iron, 1 cup

B. Mix the iron, amendment and soil thoroughly for use in the top 8 inches of backfill around plants. For acid loving plants, mixture to be 1/2 soil from the hole and 1/2 amendment.

2.4 MULCH

A. Organic Mulch: Fir or pine bark chips, dark in color; 3/4-inch to 1-inch.

B. Rock Mulch: Black Basalt

C. Material: Hard, durable, angular crushed stone, color: charcoal to near-black.

D. Size: Nominal ¼ inch diameter.

E. Shape: Angular crushed stone, not rounded river rock; minimal fines allowed to fill interstices.

F. Placement: Use as mulch/top-cover in planting beds and landscape areas as indicated on drawings, to a uniform depth of [specify, e.g., 2"] over prepared soil/subgrade. Install over weed barrier fabric unless otherwise noted.

G. Submittal: Contractor shall provide sample for approval demonstrating color, size, and angularity prior to full installation.

H. Installation: Place after planting and irrigation/drainage work is complete. Rake to uniform coverage, maintain clean edges at hardscape interfaces, and remove stray stones from adjoining paving.

I. Maintenance: Stone mulch shall retain color and shape under normal exposure. Dust and debris shall be rinsed off after installation. Contractor to maintain uniform coverage as part of regular landscape maintenance.

J. Submit samples of organic and rock mulches to the Landscape Architect for approval.

2.5 TREE SUPPORT POLES:

A. Peeled lodge pole pine logs, clean, smooth, new, and sized as follows:
1. Two-inch (2") diameter by eight feet (8') long for trees less than 8' high and 1" caliper.
2. Three-inch (3") diameter by eight to ten feet (8' - 10') long for trees greater than 8' high and 1" caliper.

2.6 TIES

A. Rubber strap, 24-inch minimum length without sharp edges adjacent to trunk, V.I.T. cinch-tie, Dublin, CA, (818)882-9530, or equal.

2.7 FILTER FABRIC

A. Polyester or polypropylene non-woven filter fabric with uniform fiber distribution by "Terra Bond" #1115, "Mirafi, Inc." #140N, or approved equal.

2.8 ROOT BARRIER

A. Black, molded, modular panels 18 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.

B. Available from Deeproot or equal. https://www.deeproot.com/products/root-barrier

2.9 RECESSED MODULAR TREE GRATE SYSTEM AT WOOD DECKING

A. Pavement Suspension System: Manufacturer's standard galvanized steel paver suspension system consisting of structural steel perimeter frame, center frame, support members, structural grating, and accessories required for installation.
   1. Manufacturer: Ironsmith or equal.
      a. Contact: 41-701 Corporate Way #3; Palm Desert, CA; 92260; (800) 338-4766.
   2. Model: 6220 Paver-Grate/ Tree Grate

B. Materials:
   1. Perimeter Frame: ASTM 36 steel angle and tube sections.
   2. Perimeter Trim: 1/2"-inch square steel bar.
   3. Structural Grating: No. 3 structural steel catwalk grating.
   4. Finish: Hot-dip galvanized after fabrication.

C. Adjustable Center Frame:
   1. 1. Provide manufacturer's adjustable center frame assembly capable of accommodating wood deck system thickness indicated and achieving required elevations.
   2. 2. Coordinate adjustment range with decking materials and installation tolerances to ensure top of tree grate is flush with adjacent finished paving surface.
   3. 3. Shim, adjust, and install assembly as required to provide continuous walking surface free of abrupt changes in elevation.

D. Fabrication and Coordination:
   1. Fabricate system to dimensions indicated on Drawings.
   2. Verify dimensions, adjacent conditions, paving thickness, and field conditions prior to fabrication.

2.10 UNDERGROUND TREE GUYING (TREE STABILIZATION SYSTEM)

A. Manufacturer: Platipus Anchors, Ltd. Or approved equal.

B. Model: RF3P 4-Leg Rootball Fixing System or approved equal.

C. Components:
   1. Four (4) Platipus S8 anchors.
   2. Two (2) lengths of 26-foot galvanized wire cable.
   3. Two (2) galvanized steel ratchet tensioners.
   4. Four (4) Plati-Mats for rootball protection.

D. Tree Size: Suitable for 48-inch to 60-inch box trees.

E. Anchor Installation Depth: Anchors shall extend well below the rootball, into competent supporting substrate, or to the depth specified by the manufacturer, to provide proper tree stabilization.

F. Material:
   1. Anchors – corrosion-resistant galvanized steel.
   2. Cables – galvanized steel wire rope, min. 5 mm (3/16") diameter.

3. Tensioners – galvanized steel, with self-locking mechanism.
4. Plati-Mats – heavy-duty geotextile pads for trunk and rootball protection.

G. Performance Requirements:
1. Anchoring system shall resist minimum ultimate load of 1330 lb (6.0 kN) per anchor.
2. System shall maintain tree in upright position under design wind load.
3. Installed system shall be fully concealed below finish grade.
4. Installation Accessories:
5. Installation rod and drive tool as required for anchor installation.
6. Load-locking device for tensioning and proof testing.

2.11 LANDSCAPE METAL EDGING

A. Manufacturer: Permaloc https://permaloc.com/ or approved equal.

B. Type 1 (Between Planting Area and Rock Mulch)
1. Model: Permaloc CleanLine XL or approved equal.
2. Height: 5 inches.
3. Material: Extruded aluminum alloy 6063, T-6
4. 8'-0" sections shall include (3) 18" aluminum stakes and (3) xlr adaptors.
5. 16'-0" sections shall include (5) 18" aluminum stakes and (3) xlr adaptors.
6. Corners - cut base edging up halfway and form a continuous corner.

C. Type 2 (Between planting and Decomposed Granite Paving)
1. Model: Permaloc AsphaltEdge or approved equal.
2. Height: 3" inches.
3. Material: Extruded aluminum alloy 6005, T-5
4. Color/Finish: Black Duraflex
5. Section shall have holes in base spaced 4 inches apart along its length to receive 3/8 inch x 10 inch spiral steel spikes.

D. Compacted base must extend 8 inches beyond the edge of rock installation.

E. Install per manufacturer recommendations.

PART 3 - EXECUTION

3.1 FINE GRADING AND SOIL PREPARATION

A. General: Soil in all planting areas shall be moist, but not so moist that it sticks to a hand shovel, and loose and friable to a minimum depth of 12 inches with a relative maximum compaction of 85%. Rip and scarify and dry any areas that do not meet this requirement.

B. Planting Soil Placement:
1. Inspect planting areas and remove all base rock and other foreign material Rip all planting areas, except within CRZ of existing trees to be retained, in two directions full depth of compacted fill (to a minimum of 6 inches) into undisturbed native soil prior to backfilling. Scarification of any planting area which cannot be accomplished with a tractor shall be accomplished by an alternative method approved by the Landscape Architect to the specified depth to ensure proper drainage.

2. Prior to placing planting soil secure the Landscape Architects acceptance of the planting areas subgrade condition. After acceptance of the planting areas subgrade condition, uniformly distribute and spread planting soil backfill over scarified subgrade as specified in planting areas and compact to a maximum of 85% relative compaction.
3. Do not work planting soil in a wet or muddy condition or dump or spread in areas where subgrade is not in proper condition.
4. Water settling, puddling, and jetting of fill and backfill materials as a compaction method is not acceptable.
5. Provide a minimum of 12 inches depth in planting areas, or more where shown or specified otherwise.

C. Planting Soil Placement in Planting Islands and Adjacent to Pavement Areas: Provide planting soil as a final lift in all planting areas within and adjacent to paved areas and other construction where native site soil has been covered by engineered fill and/or base rock. Remove all engineered fill, base rock and compacted subgrade full depth of compaction and replace with approved planting soil, a minimum lift of 12 inches unless shown otherwise, finish grade in planting islands shall be crowned with a minimum 2 % pitch to the edges.

D. All planting areas soil shall be loose and friable prior to planting. Rip any overly compacted and re-compacted planting areas in two directions full depth of compacted soil prior to planting.

E. Before proceeding with the work: Carefully inspect all areas and verify all dimensions and quantities. Immediately inform the Landscape Architect of any discrepancy between the drawings and specifications and actual conditions and secure approval to proceed. Irrigation system should be fully installed, texted and verified prior to plant installation.

F. Planting operations shall be performed only during periods when beneficial results can be obtained. When excessive moisture or other unsatisfactory conditions prevail, the work shall be stopped until conditions are satisfactory.

G. Thoroughly wet down the planting areas to settle the soil and confirm irrigation coverage and operation. Allow soil to dry so as to be workable as described herein.

H. Drag to a smooth, even surface. Grade to form all swales, pitch to catch basins, streets, curb, etc., to ensure uniform surface drainage. Areas requiring grading include adjacent transition areas that shall be uniformly level or sloped between finish elevations. Refer to Erosion Control Netting below for treatment of slopes 3:1 and steeper.

I. Finish Grade: Hold finish grade and/or mulch surface in planting areas1/2-inch below adjacent pavement surfaces, tops of curbs, manholes, etc. The subgrade of the mulch in mulched planting areas shall be a minus 2 inches for a distance of 12 to 18 inches from the edge of pavement. The remainder of the planting area shall be graded to receive the required 3-inch layer of mulch.

J. In Existing On-Site (Situ Soil) Preparation:
1. Spread organic amendment, iron and Type A fertilizer evenly over installed and rough graded on-site topsoil in all planting areas including turf, ground cover and shrub areas at the following rates:
   a. Organic Amendment: 6 cubic yards per 1,000 square feet
   b. Fertilizer: Type A (6-20-20) at 20 lbs. per 1,000 square feet.
   c. Iron Sulfate: 10 lbs. per 1,000 square feet

2. In the case of a contradiction between the quantity of organic amendment required by the Contractor-obtained soils laboratory analysis and the specified quantity shown above, the greater of the two quantities shall take precedence.
3. Rototill above additives into soil 6 to 8 inches deep. Keep iron sulfate off pavement and other surfaces to prevent rust staining. Correct all rust damage to work.

K. After the rototill work, float areas to a smooth, uniform grade as indicated on the drawings. Slope all planting areas to drain. Roll, scarify, rake and level as necessary to obtain true, even planting surfaces. Remove rocks, sticks and debris 2 inches or larger in size in turf areas and 3 inches or larger in shrub and ground cover areas. Secure approval of the grade by the Landscape Architect before any planting.

3.2 TREE AND SHRUB PLANTING

A. Mark tree and shrub locations on site using stakes, gypsum or similar approved means and secure location approval by the Landscape Architect before plant holes are dug. Adjust location as necessary prior to planting.

B. Test drainage of plant beds and pits by filling with water (minimum 6"). The retention of water in planting beds and plant pits for more than two (2) hours shall be brought to the attention of the Landscape Architect. If rock, underground construction work, tree roots, poor drainage, or other obstructions are encountered in the excavation of plant pits, alternate locations may be selected by Landscape Architect.

C. Break and loosen the sides and bottom of the pit to ensure root penetration and water test hole for drainage as required above.

D. Backfill plant holes with mix as specified, free from rocks, clods or lumpy material. Backfill native soil free of soil amendments under rootball and foot tamp to prevent settlement. Backfill remainder of the hole with soil mix and place plant tablets or packets (Type B fertilizer) 3 inches below finish grade and 1/2-inch from roots at the following rates:

1 gallon plant	-	1 tablet or packet
5 gallon plant	-	3 tablets or packet
15 gallon plant	-	6 tablets or packet
24-inch plant	-	6 tablets or packet
36-inch plant	-	8 tablets or packet

E. Carefully remove and set plants without damaging the rootball. Superficially cut edge roots vertically on three sides. Remove bottom of plant boxes before planting. Remove sides of boxes after positioning the plant and partially backfilling.

F. Set plants in backfill with top of the rootball 2 inches above finished grade. Backfill remainder of hole and soak thoroughly by jetting with a hose and pipe section. Water backfill until saturated the full depth of the hole.

G. Build 6" high watering basin berms around trees and shrubs to drain through rootball. Basins are not required around trees in turf areas.

H. Stake and/or guy trees as detailed. Drive stake until solid and remove excess stake protruding above top tree tie to prevent rubbing against branches.

I. Remove any soil from top of plant rootballs and secure Landscape Architect approval of rootball height prior to mulching.

J. After approval of rootball height, install as required below.

3.3 ROOT BARRIER

A. Install in continuous sheet parallel and adjacent to curb or pavement edge for a distance of 8 feet on each side of tree trunk where tree is within 8 feet of paving, as required on drawings and in accordance with manufacturer's recommendations.

B. For trees further than 8 feet from hardscape, root barriers are not required unless otherwise directed by the landscape architect.

C. Set top of barrier approximately ½-inch above finished soil surface to allow concealment with mulch, as accepted by Owner's Representative.

D. Backfill trench with native or imported soil, compact lightly to avoid damage to the barrier.

E. Cut barrier only as necessary to accommodate utilities or obstructions, maintaining barrier integrity.

3.4 MODULAR RECESSED TREE GRATE SYSTEM AT WOOD DECKING

A. Install tree grate system in accordance with manufacturer's instructions and approved shop drawings.

B. Ensure frame is level, securely supported, and seated flush with decking surface without deflection under pedestrian loading.

C. Confirm tree location, orientation, and plumb position prior to final fastening. Landscape Architect to review tree placement and grate alignment on site before securing.

D. Coordinate installation with:
   1. Underground tree guying system, including anchor locations and cable paths.
   2. Deep root watering or inspection tubes.
   3. Wood deck contractor to ensure proper alignment with decking boards and structural members. Tree grate trays shall receive wood boards, and the top of the boards shall be flush with the surrounding wood decking.

E. Provide protection to tree rootball during installation using Plati-Mats or similar protective materials.

F. Secure all fasteners and locking devices as recommended by the manufacturer; conceal attachments below finished decking or mulch where feasible.

G. After installation, verify stability and alignment; adjust as necessary to maintain flush alignment with decking and clearances for tree growth.

3.5 UNDERGROUND TREE GUYING (TREE STABILIZATION SYSTEMS)

A. Preparation:

1. Excavate and install anchors per manufacturer's instructions and recommendations for soil type.
2. Landscape Architect shall review tree location, rootball placement, orientation, and angle on site prior to installing anchors or tensioning system.
3. Position anchors symmetrically around rootball, 120°–90° apart depending on configuration.
4. Use Plati-Mats under cable where it contacts the rootball to protect root system.
5. Coordinate anchor locations with deck / structural planter design to avoid conflicts with structural elements, utilities, or irrigation.

B. Tensioning:
1. Apply uniform tension to each cable using ratchet tensioners until the tree is secure and upright.
2. Verify that tensioning does not distort rootball or damage root structure.
3. Cut excess cable and conceal tensioners below mulch layer.

C. Adjustment and Inspection:
1. Inspect after installation and again after initial irrigation to confirm tree remains plumb.
2. Adjust tension if settlement occurs.
3. Coordinate anchor and cable locations with installation of deep root watering system to avoid conflicts.

3.6 MULCH

A. Except where rock mulch is required, mulch all tree, shrub and ground cover areas with organic mulch to a 3-inch depth, except adjacent to walkways where soil grade is 2 inches below top of pavement, mulch shall be 2 inches deep. Hold bark mulch away from base (trunk) of plant 4" or as approved by Landscape Architect. Individual trees and/or shrubs planted in non-irrigated areas shall, at minimum, receive bark mulch over their watering basin and berm. No mulch is required around trees in turf areas.

B. Install rock mulch to a (3" depth) in all locations shown on the drawings and specified in the details.

3.7 GROUND COVER PLANTING

A. Plant in neat, straight, parallel and staggered rows as indicated on plan. Plant first row one-half required ground cover spacing behind adjacent curbs, structures, or other plant bed limits. Plant ground cover to edge of water basins of adjacent trees and shrubs.

3.8 PRE-EMERGENCE WEED KILLER

A. Apply pre-emergence weed killer in all areas to receive ground cover planting. Work shall be done under the supervision of a person licensed by the State of California as a pest control applicator and holding a qualified applicator license or a Qualified Applicator Certificate. Obtain approval of the finish grades prior to applying weed killer and coordinate planting and watering with the pest control specialist prior to planting. Take care to keep weed killer off areas to be seeded.

3.9 WATERING

A. Water all trees, shrubs and ground cover immediately after planting. Apply water to all plants as often and in sufficient amount as conditions may require to keep the plants in a healthy vigorous growing condition until completion of the Contract. Do supplemental hand watering of trees and shrubs during the first 3 weeks of plant establishment.

3.10 MAINTENANCE OF PLANTING

A. Maintain plants from time of delivery to site until final acceptance of landscape installation.

3.11 PRE-MAINTENANCE PERIOD REVIEW AND APPROVAL OF PLANTING

A. Receive approval of the installed planting prior to commencement of planting establishment maintenance period. Notify the Landscape Architect a minimum of seven (7) days prior to requested review. Before the review, complete the following:
   1. Complete all construction work.
   2. Present all planted areas neat and clean with all weeds removed and all plants installed and appearing healthy.
   3. Plumb all tree stakes.
   4. Seed all turf areas.
   5. No partial approvals will be given.

3.12 PLANTING ESTABLISHMENT MAINTENANCE

A. General Requirements:
   1. Maintenance Period: The planting establishment maintenance period required shall be 180 calendar days after all planting is complete, turf is seeded, and installation approved. A longer period may be required if the turf is not thick, vigorous and even and has been mowed a minimum of 4 times, or if the plant material is not acceptably maintained during the maintenance period. The maintenance period may be suspended at any time upon written notice to the Contractor that the landscaping is not being acceptably maintained, and the day count suspended until the landscape is brought up to acceptable standards as determined by the Landscape Architect.
   2. Planting establishment maintenance immediately follows, coincides with, and is continuous with the planting operations, and continues through turf installation, and after all planting is complete and accepted; or longer where necessary to establish acceptable stands of thriving plants.
   3. Protect all areas against damage, including erosion, trespass, insects, rodents, disease, etc. and provide proper safeguards. Maintain and keep all temporary barriers erected to prevent trespass.
   4. Keep all walks and paved areas clean. Keep the site clear of debris resulting from landscape work or maintenance.
   5. Repair all damaged planted areas and replace plants and reseed or resod turf immediately upon discovery of damage or loss.
   6. Check sprinkler systems at each watering; adjust coverage and clean heads immediately. Adjust timing of sprinkler controller to prevent flooding.

7. Maintain adequate moisture depth in soil to ensure vigorous growth. Check rootball of trees and shrubs independent of surrounding soils and hand water as required.
8. Keep Contract areas free from weeds by cultivating, hoeing or hand pulling. Use of chemical weed killers will not relieve the Contractor of the responsibility of keeping areas free of weeds over 1-inch high at all times.

B. Tree, Shrub and Ground Cover Maintenance:
1. Maintain during the entire establishment period by regular watering, cultivating, weeding, repair of stakes and ties, and spraying for insect pests. Prune when requested by the Landscape Architect.
2. Keep watering basins in good condition and weed-free at all times.
3. Replace all damaged, unhealthy or dead trees, shrubs, vines and ground covers with new stock immediately; size as indicated on the drawings.

C. Fertilizing:
1. Upon approval and after submitting fertilizer delivery tags, maintenance fertilization shall begin 30 days after planting is complete. Fertilize all turf and ground cover areas by broad-casting Type C (21-7-14) fertilizer at the rate of 5 lbs. per 1,000 square feet evenly throughout. Reapply every forty-five (45) days until acceptable.
2. During the winter, for quick turf greening effect, calcium nitrate (15.5-0-0) may be applied at the rate of 6 lbs. per 1,000 square feet.
3. Early spring and fall substitute a complete fertilizer such as 15-15-15 applied at the rate of 6 lbs. per 1,000 square feet, to help insure continuing adequate phosphorus and potassium.
4. Apply ammonium sulfate fertilizer as necessary to maintain vigorous, green grass between fertilizations mentioned above.
5. Observe plant's color, and if a soil pH imbalance is suspected, take soil samples and obtain laboratory analysis for confirmation. Take necessary action recommended in laboratory analysis such as top dressing with soil sulfur, leaching soil, etc.

3.13 FINAL PLANTING REVIEW AND ACCEPTANCE

A. At the conclusion of the Maintenance Period, schedule a final review with the Landscape Architect. On such date, all project improvements and all corrective work shall have been completed.

B. Submit written notice requesting review at least 10 days before the anticipated review.

C. Prior to review, weed and rake all planted areas, repair plant basins, mow and edge turf, plumb tree stakes, clear the site of all debris and present in a neat, orderly manner.

END OF SECTION

SECTION 33 30 00 - SANITARY SEWERAGE UTILITIES

PART 1 - GENERAL

1.1 SUMMARY

A. Site sanitary sewerage piping, fittings, accessories and bedding.

B. Cleanouts.

1.2 RELATED SECTIONS

A. Section 31 20 00 - Earthwork.

B. Section 31 23 33 - Trenching and Backfilling.

1.3 REFERENCES

A. *City of San Buenaventura Standard Plans,* latest edition.

B. *Standard Specifications for Public Works Construction (SSPWC)*, latest edition.

C. *Standard Plans for Public Works Construction (SPPWC)*, latest edition.

D. Geotechniques (2025), "*Geotechnical Study, Student Housing at SW Campus Lot, Ventura College*" Project No. 1003.010.03, dated February 28.

1.4 SUBMITTALS

A. Submit:
1. Product Data: Provide data indicating pipe, pipe accessories and appurtenances, and manhole covers.
2. Manufacturer's Installation Instructions: Indicate special procedures required to install products specified.
3. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
4. Manufacturer's Certificate: Certify that installers are certified for installing plastic pipe.

1.5 PROJECT RECORD DOCUMENTS

A. Submit Record Drawings: Record location of pipe runs, connections, manholes, cleanouts, and invert elevations.

B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.6 REGULATORY REQUIREMENTS

A. Conform to California Title 24 (CCR) Part 5, latest edition, for installation of the Work of this section.

B. Minimum separation distance and requirements between water, reclaimed water and sewer pipes per the State of California, Department of Health Services shall be established.

PART 2 – PRODUCTS

2.1 SEWER PIPE MATERIALS AND ACCESSORIES

A. Polyvinyl Chloride (PVC) Pipe for Gravity Sewer: ASTM 3034-SDR35 Ring-Tite Polyvinyl Chloride (PVC) gravity sewer pipe and fittings; inside nominal diameter as indicated on Drawings. PVC pipe shall use "locked-in" rubber sealing ring conforming to ASTM D-3212. Joints using flexible Elastomeric Seals. Minimum pipe stiffness at 5 percent deflection shall be 46 psi for all sizes when tested in accordance with ASTM Method of Test D2412.

B. Appropriate warning detector tape shall be placed over all utilities.
1. Underground detectable warning tape shall be placed over all non-metallic underground utilities.

2.2 CLEANOUTS

A. Form and cast-in-place, Class 450-C-2000 concrete base pad, with provisions for sewer pipe end section in accordance with SPPWC Standard Detail No. 204-2.

B. Frame and cover shall be cast-iron Alhambra Foundry Model A-1240 or equal, lettered "SEWER".

2.3 BEDDING MATERIALS

A. Bedding: Bedding materials shall be sand or with a minimum Sand Equivalent (S.E.) of 30.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that trench cut and/or excavation base is ready to receive work and excavations, dimensions, and elevations are as indicated on drawings.

3.2 PREPARATION

A. Hand trim excavations to required elevations. Correct over excavation with granular fill.

B. Remove large stones or other hard matter which could damage pipe or impede consistent backfilling or compaction.

3.3 BEDDING

A. Excavate pipe trench in accordance with Specification Section 31 23 33, Trenching and Backfilling. Hand-trim excavation for accurate placement of pipe to elevations indicated on drawings.

B. Place bedding material at trench bottom, level materials in continuous layer not exceeding 6-inches compacted depth, compact to minimum 95% relative density.

C. Maintain optimum moisture content of bedding material to attain required compaction density.

3.4 INSTALLATION - PIPE

A. Install pipe, fittings and accessories in accordance with manufacturer's instructions.

B. Sewer pipeline shall be placed from downstream to upstream beginning at the downstream connection to the existing sewers.

C. Lay pipe to slope gradients noted on drawings; with maximum variation from true slope of 1/8 inch in 10 feet.

D. Install bedding along sides and over top of pipe to minimum compacted thickness of 12 inches; compacted to 95 percent density.

E. Refer to Specification Section 31 23 33, Trenching and Backfilling for trenching requirements. Do not displace or damage pipe when compacting.

F. Install continuous trace wire over top of pipe.

G. Connect to building sanitary sewer lateral at 5-foot outside of edge of building.

H. The compaction of the backfill material along the sides and one foot above the pipe shall be done with hand tampers to protect the pipe.

3.5 INSTALLATION – CLEANOUTS

A. Refer to SSPWC standard plan 204-2.

B. Form bottom of excavation clean and smooth to correct elevation.

C. Establish elevations and pipe inverts for inlets and outlets as indicated on plans.

D. Mount lid and frame level in grout, secured to cone section to elevation indicated on drawings.

3.6 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed by the District's Testing Laboratory.

B. Request inspection prior to, and immediately after placing bedding.

C. Compaction testing will be performed in accordance with ASTM D1557 by the District's Testing Laboratory.

D. If tests indicate work does not meet specified requirements, remove work, replace and retest at no cost to the District.

3.7 FIELD TESTS ON INSTALLED SEWER PIPE

A. Preliminary Tests: The Contractor may perform any tests desired which are not harmful to the lines before backfilling is completed.

B. Cleaning: Before final tests are performed for acceptance of any sewer pipe, clean the pipe by inflatable rubber ball method.

C. Perform air pressure test per SSPWC Section 306-7.8.

D. Repairs, if necessary: If the leakage or infiltration is greater than the amount specified, the pipe shall be overhauled and re-laid if necessary by the Contractor, at its own expense, until the joints will hold satisfactorily.

E. Regardless of the results of the above tests, any visible evidence of individual leaks shall be corrected by the Contractor to the satisfaction of the District Representative.

F. Cleaning Sewer: After all backfilling, compaction testing and paving is completed, sewer lines shall be cleaned by Inflatable Rubber Ball Method, flushed and cleaned, before acceptance by the District Representative and connection to their sewer system is made.

G. The Contractor shall furnish all sewer line plugs necessary for blocking off all lines as required by the District Representative until final acceptance.

3.8 PROTECTION

A. Protect finished installation.

B. Protect pipe and aggregate cover from damage or displacement until backfilling operation is complete.

END OF SECTION

SECTION 33 40 00 - STORM DRAINAGE UTILITIES

PART 1 - GENERAL

1.1 SUMMARY

A. Site storm drainage piping, fittings, accessories, and bedding.

B. Catch basins.

C. Trench drains.

D. Wall drains.

E. Cleanouts

1.2 RELATED SECTIONS

A. Section 31 20 00 – Earthwork.

B. Section 31 23 33 – Trenching and Backfilling.

1.3 REFERENCES

A. *Standard Specifications for Public Works Construction (SSPWC)*, latest edition.

B. *Caltrans Standard Plans,* latest edition.

C. *Caltrans Standard Specifications,* latest edition.

1.4 SUBMITTALS

A. Submit the following:

1. Product Data: Provide data indicating pipe, pipe accessories and catch basin grates.
2. Manufacturer's Installation Instructions: Indicate special procedures required to install Products specified.
3. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
4. Layout diagram for storm drain components per plan.

1.5 PROJECT RECORD DOCUMENTS

A. Submit record drawings. Accurately record locations of pipe runs, connections, catch basins, structures, and invert elevations.

B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.6 FIELD MEASUREMENTS

A. Verify that field measurements and elevations are as indicated on drawings.

B. Complete pothole work per plans and notify the Owner of any discrepancy prior to commencing construction

1.7 COORDINATION

A. Coordinate the work with connection to existing storm drain mains, and trenching.

PART 2 – PRODUCTS

2.1 PIPE MATERIALS

A. Corrugated High Density Polyethelyne (HDPE) Pipe and Fittings
   1. HDPE Drainage Pipe and Fittings, NPS 3 to NPS 10: AASHTO M252, Type S, with bell-and-spigot ends. Gasketed joints shall be water-tight per ASTM D3212.
   2. HDPE Drainage Pipe and Fittings, NPS 12 to NPS 60: AASHTO M294, Type S, or ASTM F2306 with bell-and-spigot ends. Gasketed joints shall be water-tight per ASTM D3212

B. Perforated Polyvinyl Chloride (PVC) Pipe and Fittings
   1. PVC Perforated Drainage Pipe and Fittings, NPS 4: ASTM D3034, SDR 35, with bell-and-spigot ends. Perforations shall conform to ASTM D2729 or manufacturer's standard pattern. Joints shall be gasketed and water-tight per ASTM D3212 where non-perforated connections occur

2.2 PIPE ACCESSORIES

A. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers, traps and other configurations required. Fittings shall be watertight.

B. Appropriate warning detector tape shall be placed over all utilities.
   1. Underground detectable warning tape shall be placed over all non-metallic underground utilities.

2.3 CATCH BASINS

A. Precast catch basins shall include traffic-rated and pedestrian-rated grate, as manufactured by Pre-Con or approved equal.

2.4 METAL

A. All exposed metal parts are to be galvanized in accordance with SSPWC Section 210-3 unless otherwise directed.

2.5 CONCRETE

A. Catch basins shall be Class 560-C-3250 Portland Cement Concrete per SSPWC Section 201-1.

B. Concrete flared end section shall comply with Section 70-5.02 of the Caltrans Standard Specifications and Caltrans Standard Plan No. D94B.

2.6 BEDDING MATERIALS

A. Bedding materials shall be sand with a minimum Sand Equivalent (S.E.) of 30.

2.7 AREA DRAINS

A. Area drains to be NDS atrium drain or round grate as indicated on plans.

2.8 TRENCH DRAINS

A. Trench drains to be NDS Dura Slope with Ductile Iron Frame (DS-200H) with Cast Ductile Iron Heel-Proof Rain 6" grate (RNN6-24I03HP) by Iron Age, baked on oil finish.

2.9 WALL DRAINS

A. Filter fabric for wall drain to be Mirafi 140N or approved equal.

B. Gravel for wall drain to be ¾" to 1" gravel.

2.10 CLEANOUTS

A. Form and cast-in-place, Class 450-C-2000 concrete base pad, with provisions for storm sewer pipe end section in accordance with SPPWC Standard Detail No. 204-2.

B. Frame and cover shall be cast-iron Alhambra Foundry Model A-1240 or equal, lettered "STORM".

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that trench cut is ready to receive Work and excavations, dimensions, and elevations are as indicated on Drawings.

3.2 PREPARATION

A. Hand trim excavations to required elevations. Correct over excavation with compacted bedding material.

B. Remove large stones or other hard matter which could damage piping or impede consistent backfilling or compaction.

C. Compact top 8" of native material or backfill to minimum 95% relative dry density.

3.3 BEDDING

A. Place sand bedding material in trench bottom, level materials in continuous layer. Bedding shall be 4-inch minimum thickness, compact to 95% relative dry density.

B. Maintain optimum moisture content of bedding material to attain required compaction density.

3.4 INSTALLATION - PIPE

A. Install pipe, fittings, and accessories in accordance with manufacturer's instructions.

B. Lay pipe to slope gradients noted on drawings; with maximum variation from true slope of 1/8 inch in 10 feet.

C. Install sand backfill along sides and over top of pipe. Provide sand backfill over top of pipe to minimum compacted thickness of 12 inches, compacted to min. 95% relative dry density.

D. Do not displace or damage pipe when compacting.

E. The compaction of the backfill material along the sides and one foot above the pipe shall be done with hand tampers or equal to protect the pipe.

3.5 INSTALLATION – WALL DRAINS

A. Place filter fabric along the wall and trench bottom.

B. Install perforated pipe at base of wall, with perforations oriented downward. Establish a continuous minimum slope of 0.5% toward outlet.

C. Surround pipe with clean gravel, maintaining a uniform 12-inch column thickness from wall face.

D. Wrap fabric completely around gravel column and overlap edges a minimum of 12 inches.

E. Connect wall drain to outlet pipe or storm drainage system as indicated on plans.

3.6 INSTALLATION - CATCH BASINS

A. Form bottom of excavation clean and smooth to correct elevation.

B. Establish elevations and pipe inverts for inlets and outlets as indicated on drawings.

C. Compact top 12-inch of native materials below the bottom of catch basins to minimum 95% of relative density.

3.7 INSTALLATION – CLEANOUTS

A. Refer to SSPWC standard plan 204-2.

B. Form bottom of excavation clean and smooth to correct elevation.

C. Establish elevations and pipe inverts for inlets and outlets as indicated on plans.

D. Mount lid and frame level in grout, secured to cone section to elevation indicated on drawings.

3.8 FIELD QUALITY CONTROL

A. Inspection and testing shall be performed by the Owner's Testing Laboratory.

B. Request inspection prior to and immediately after placing backfill cover over pipe.

C. If tests indicate work does not meet specified requirements, remove work, replace and retest at no additional cost to the Owner.

3.9 PROTECTION

A. Protect pipe and backfill cover from damage or displacement until backfilling operation is in progress.

END OF SECTION